Upper Tippecanoe River and Lake Association Seven Lakes Diagnostic Study/Watershed Management Plan

Draft - Subject to Revision

Prepared for:

Tippcanoe Environmental Lake and Watershed Foundation

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Upper Tippecanoe River Lake Association Seven Lakes Diagnostic Study/ Watershed Management Plan Executive Summary

The Upper Tippecanoe River Lake Association (UTRLA) Seven Lakes Diagnostic Study/Watershed Management Plan is the result of the combined efforts of the Tippecanoe Environmental Lake and Watershed Foundation (TELWF), the UTRLA Steering Committee, the Whitley County Soil and Water Conservation District (SWCD) office, the Noble County Surveyor's Office, the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife, the Tri-County Sewer District, the Local Lake Associations (Big, Crooked, Goose, Loon, New, and Old Lakes), and Local Residents, Landowners, and Farmers. This group met throughout the planning phase to discuss social issues, identify public outreach topics, define water quality issues and their potential sources, and prioritize and develop management goals.

The UTRLA Watershed collects runoff from 13,422 acres of Northern Indiana. It is composed of the two most upstream 14-digit HUC subwatersheds of the Upper Tippecanoe River Watershed, and drains predominantly agricultural areas within Noble and Whitley Counties. As an effort to improve water quality within the Tippecanoe River Watershed, TELWF teamed with UTRLA and applied for and received a Lake and River Enhancement grant through the IDNR to develop this Diagnostic Study/Watershed Management Plan.

With this grant, the UTRLA Steering Committee, made up of government personnel, professional consultants, local lake association members, local residents and landowners, met monthly with the mission to *coordinate resources and share information between local lake associations and with other watershed stakeholders, and develop and implement strategies to help protect and improve water quality in the Upper Tippecanoe River Watershed and its lakes.* Based on steering committee input and IDNR guidance, this plan addresses nonpoint sources of pollution by summarizing readily available water quality data, collecting supplemental data where provided for by the grant, identifying and prioritizing critical areas, and proposing possible locations for Best Management Practices (BMPs) capable of improving water quality.

Through these efforts, the UTRLA steering committee strives to achieve improved water quality with the following goals:

Goal 1: Create a weed management program that balances the needs of multiple lake users.

Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.

Goal 3: Develop sustainable fish populations that support the recreational needs of the lake users.

Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.

Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use (3) Develop sustainable fish populations that support the recreational needs of the lake users.

Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion or other threats.

Goal 7: Provide information and technical education through a wide variety of communication strategies.

Goal 8: Involve government officials in environmental issues and initiatives in the watershed.

This Watershed Management Plan should not only serve as a reference for the implementation of the recommended BMPs, but also as a reference for future water quality efforts in this area.

SECTION 1.0 INTRODUCTION

In 2006, the Tippecanoe Environmental Lake and Watershed Foundation (TELWF) submitted a Lake and River Enhancement (LARE) program grant application to the Indiana Department of Natural Resources (IDNR) Division of Fish and Wildlife. The application was for the development of a Watershed Management Plan/Diagnostic Study for the seven lakes in the upper part of the Tippecanoe watershed. The lakes include Big Lake, Crane Lake, Crooked Lake, Old Lake, New Lake, Goose Lake, and Loon Lake. The lakes are represented by the Upper Tippecanoe River Lakes Association (UTRLA). A grant was awarded in the summer of 2006 from IDNR, Division of Fish and Wildlife. TELWF Board of Supervisors reviewed several proposals for the UTRLA Watershed Management Plan and selected Williams Creek Consulting, Inc. (WCC) from Indianapolis as the contractor for the development of the Watershed Management Plan/Diagnostic Study. WCC teamed with Commonwealth Biomonitoring and Empower Results, LLC to complete the water quality data collection and facilitate public involvement, respectively.

Both the planning process and the implementation phase are non-regulatory in nature. No landowners will be forced to participate or change any current land use practices if they are not interested.

Steering Committee

The UTRLA Steering Committee was formed previous to this study to combine efforts of the seven lakes; however, this project has allowed the Committee to move through a strategic planning process that has assisted in formulating a more formal work plan and organizational structure. This new work plan and structure has provided a clear path for the organization to follow in order to obtain their goal of improved water quality.

The Steering Committee formulated the following mission statement:

> *The Upper Tippecanoe River Lake Association (UTRLA) exists to coordinate resources and share information between local lake associations and with other watershed stakeholders. UTRLA's Steering Committee is a representative group of watershed landowners focused on developing and implementing strategies to help protect and improve water quality in the Upper Tippecanoe River Watershed and its lakes.*

The UTRLA Watershed Management Plan was developed by integrating the following previous and ongoing studies:

- Upper Tippecanoe River Watershed Management Plan (July 2006)
- Design Report, Inspection Plan, Operation and Maintenance Plan, and Post-Construction Monitoring Plan – Crooked Lake (1995)
- Design Report, Inspection Plan, Operation and Maintenance Plan, and Post-Construction Monitoring Plan – Loon Lake (1995)
- A Preliminary Assessment of Big Lake, Noble County (1992-1995)
- Assessment of Watershed-Lake Interactions Influencing the Cultural Eutrophication of Little Crooked and Crooked Lakes, Indiana (April 1993)
- Crooked Lake Noble-Whitley County Cisco Population Status – 2005

- Feasibility Studies of Loon and Goose Lakes (March 1992)

Watershed management plans such as this document can help communities:

- Define and prioritize water quality issues within their watershed
- Increase public understanding and awareness about water quality issues
- Plan best management practices (BMPs) capable of improving water quality

1.1 WATERSHED SUMMARY AND LOCATION

Watersheds are defined as a region or area draining to a particular watercourse or body of water. Hydrologic Unit Codes (HUC) are a system devised to classify these drainage areas throughout the United States. These drainage areas are divided and sub-divided into successively smaller areas, 6-digit, 8-digit, 11-digit, and 14-digit, with 6-digit HUCs having the largest area and 14-digit HUCs having the smallest area. The UTRLA Watershed is comprised of two 14-digit HUC sub-watersheds (HUC 05120106010010 Tippecanoe River – Crooked Lake/Big Lake and HUC 05120106010020 Loon Lake – Goose Lake/Old Lake) within the 8-digit HUC Tippecanoe River Watershed (HUC 05120106). The Tippecanoe Watershed is part of the 6-digit Wabash River Watershed (HUC 051201).

Figure 1 shows the location and size of the 13,548 acre UTRLA Watershed relative to Indiana and the Tippecanoe River Watershed within which it is located. The UTRLA Watershed is shown in Figure 2 and is typical of the Midwest Plains landscape. It is characterized by gently rolling hills and its land use is dominated by crop production. Aerial photographs of the watersheds are provided in Figures 3 and 4.

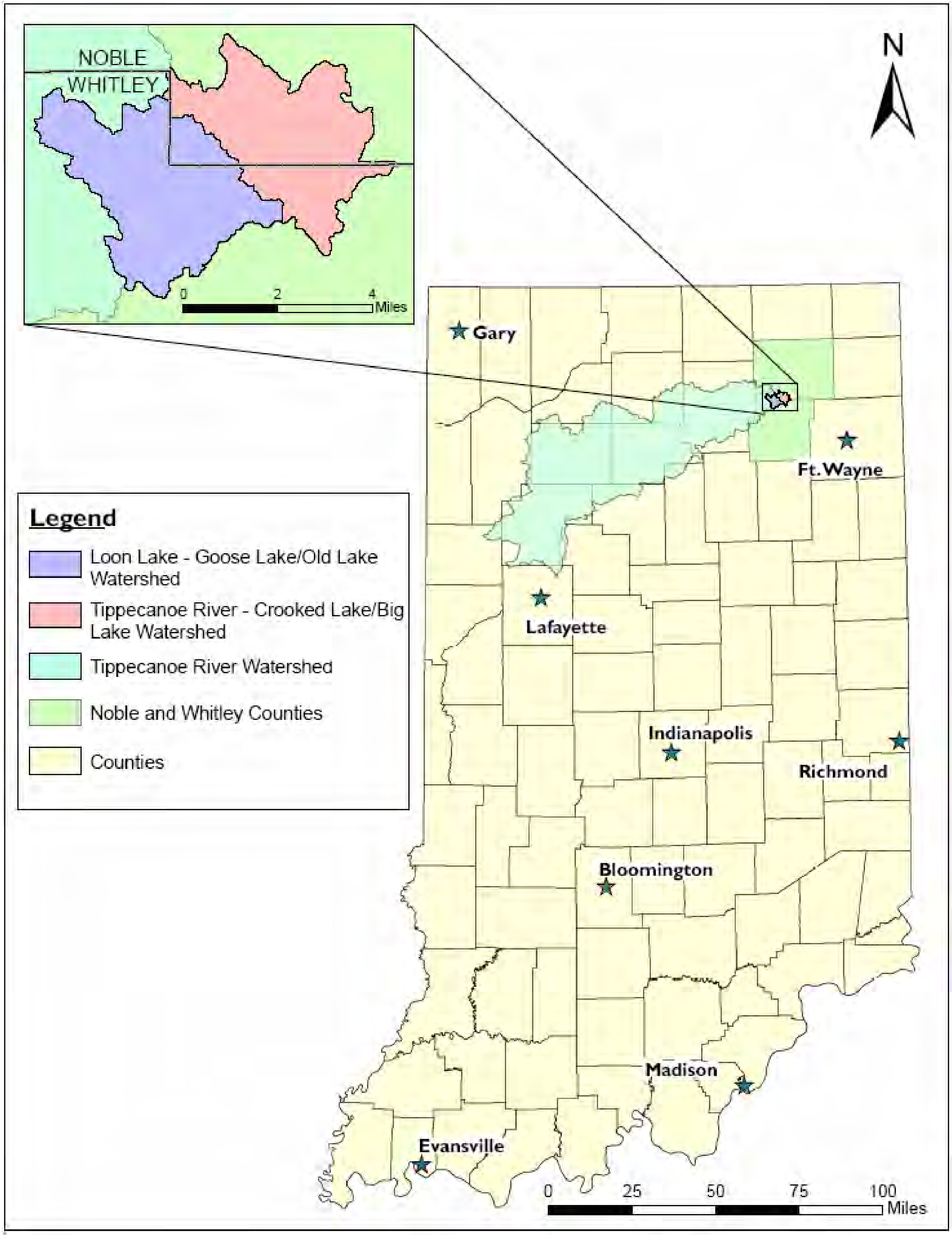


Figure 1. UTRLA Watershed Location Map

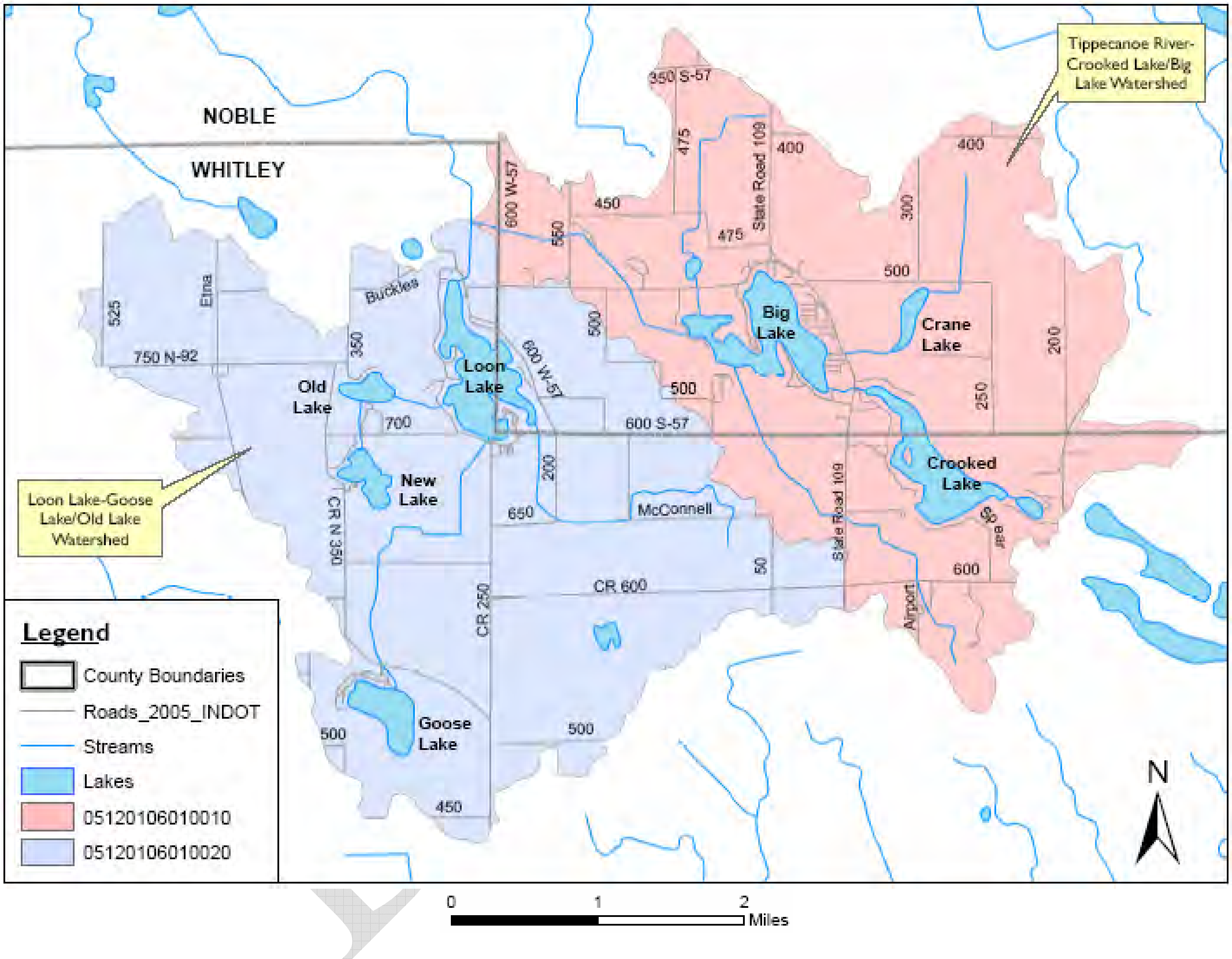


Figure 2. UTRLA Watershed

Figure 3. 2005 Aerial Photograph of Loon Lake /Goose Lake/Old Lake Watershed

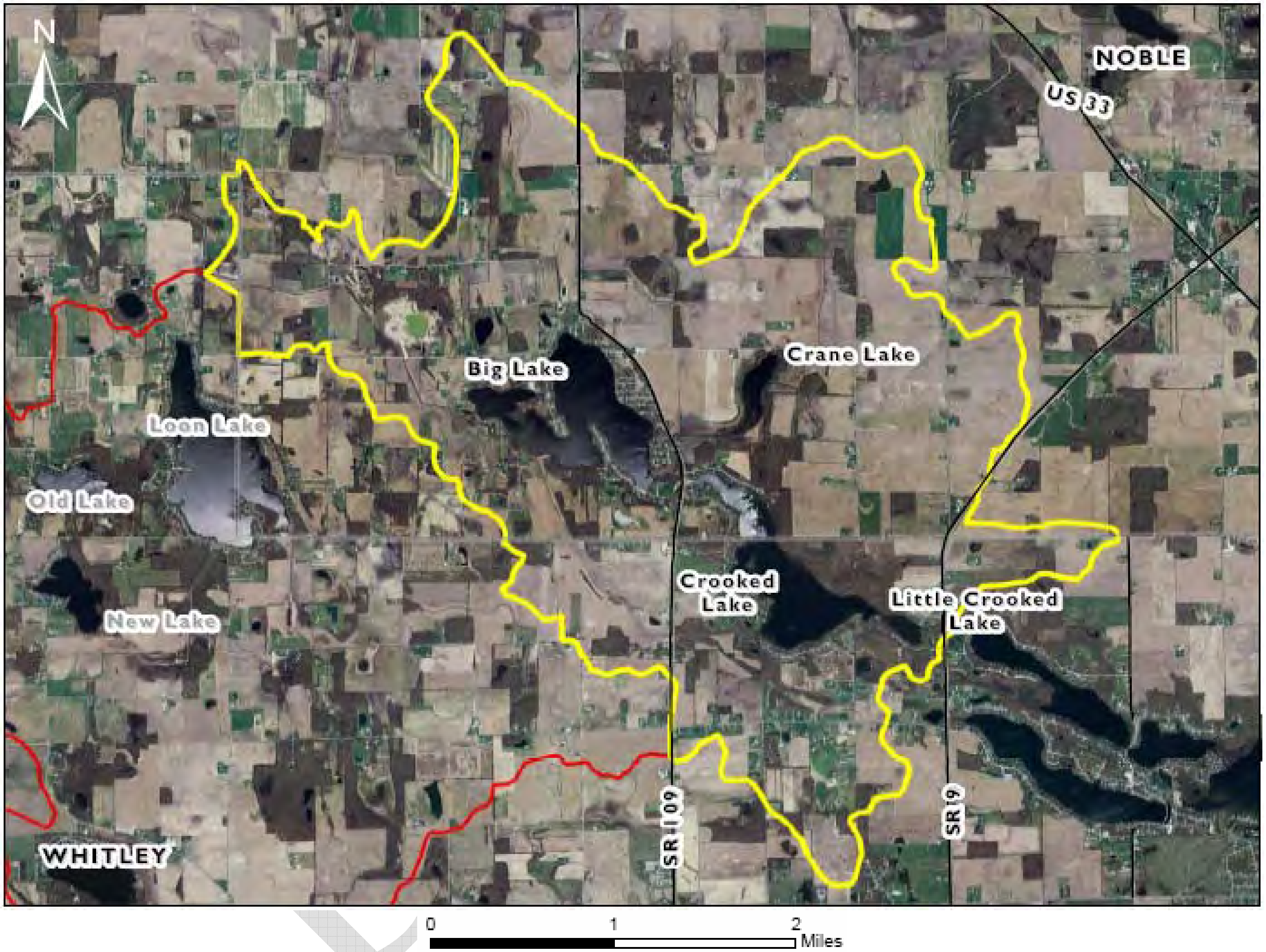


Figure 4. 2005 Aerial Photograph of Tippecanoe River – Crooked Lake/Big Lake Watershed

SECTION 2.0 PHYSICAL SETTING

2.1 NATURAL HISTORY

The current landscape of the UTRLA Watershed is the product of continental glaciation during the Wisconsinan glacial Ice Age. As the ice sheet retreated approximately 10,000 to 12,000 years ago, accumulations of glacial till were deposited, and the UTRLA Watershed was superimposed on the glacial till from the melting of the glacier. The resulting landscape is therefore flat to gently rolling.

Prior to settlement in the early 1800's, the UTRLA Watershed was primarily composed of hardwood forests, wetlands, and streams. During settlement, most of the forested land was cleared and drained to prepare it for agricultural production. Since settlement, the watershed has had active and successful agricultural production with limited urban development primarily in the area around the lakes.

2.2 SOILS

According to the Natural Resource Conservation Service (NRCS) STATSGO 2005 Soils Data, the soil associations present in the UTRLA Watershed are Blount-Glynwood-Morley, Hoytville-Nappanee-Blount, and Houghton-Adrian-Carlisle. The NRCS SSURGO descriptions of these associations can be found in Table 1.

The Blount-Glynwood-Morley association is the predominant soil association, occupying 100% of the Loon Lake/Goose Lake/Old lake 14 digit watershed and 65% of the Big Lake/Crooked Lake 14 digit watershed. These soils are deep or moderately deep to dense till. They are moderately to poorly drained soils "formed in a thin layer of loess and underlying till." The Blount-Glynwood-Morley association is typically found on ground moraines and end moraines. Houghton-Adrian-Carlisle association is located on 19% of the Big Lake/Crooked Lake watershed. The soils are deep, depressional and nearly level, very poorly drained, organic soils on lake plains, outwash plains and till plains. Hoytville-Nappanee-Blount association makes up the remaining 16% of the Big Lake/Crooked Lake watershed, in the northern part of the watershed. The soils are nearly level to gently sloping, poorly drained and somewhat poorly drained soils that have dominantly fine textured subsoil; on lake plains and till plains [U.S. Department of Agriculture, 2002]. The majority of the soils in these three associations have severe limitations for septic tank absorption fields due to slow permeability, poor filtration, and ponding resultant of high water tables. Artificial drainage is usually required for agricultural production for all of these soil associations. Figure 5 shows how the soils of the Blount-Glynwood-Morley association are related to one another, while Figure 6 shows the locations of the soils associations located in the UTRLA Watershed.

NRCS classifies soils into Hydrologic Soil Groups (HSG) A through D based on the soils' (in its current state) runoff potential. The UTRLA Watershed is composed of HSGs A and C. HSG A soils are sand, loamy sand or sandy loam types of soils. They are characterized by a low runoff potential and high infiltration rates even when thoroughly wetted, and chiefly consist of deep, well to excessively drained sands or gravels and have a high rate of water transmission. HSG C soils are sandy clay loam. They are characterized by low infiltration rates when thoroughly wetted, and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure (Purdue Research Foundation, 2004). As seen in Figures 7 and 8, the HSG A soils with high infiltration rates make up only about 10% of the UTRLA Watershed, while HSG C soils with low infiltration rates make up the large remainder (90%) of the UTRLA Watershed.

Highly erodible land (HEL) is land that is very susceptible to erosion. HEL is determined by calculating the erodibility index based on rainfall, the erodibility value of soil types, and the slope of the land. If the erodibility index is greater than eight, the land meets the criteria for HEL. The following equation is used to determine HEL:

$$EI = RKLS/T$$

EI = erodibility index
R = rainfall factor
K = erodibility value of a soil type
LS = slope factor (length and steepness)
T = soil loss tolerance

It is important to determine the HEL in the UTRLA Watershed to identify areas susceptible to erosion and therefore possibly contributing heavy sediment and nutrient loads to the tributaries and lakes of the watershed. The majority of HEL in the UTRLA Watershed occurs in the forested, row crop, and grassland land uses. A multitude of agricultural BMPs should be implemented on agricultural land that is classified as HEL in an effort to reduce soil erosion on these lands. These BMPS include, but are not limited to conservation tillage, buffer strips, grassed waterways, winter cover crops, and rotational grazing. Erosion control measures, such as silt fences and temporary seeding, should be installed and regularly maintained on construction sites occurring on HEL in an effort to reduce erosion. Vegetated buffers, streambank stabilization, and grade control are some other BMPs that reduce erosion, therefore reducing the amount of sediment and nutrients being loaded into waterbodies. The HEL soils of the UTRLA Watershed are mapped in Figure 9.

Hydric soil is soil that, in its undrained state, is saturated long enough during a growing season to develop anaerobic conditions that support the growth and regeneration of hydrophytic vegetation (plants specialized to grow in saturated conditions). Hydric soils are usually found in wetlands. Hydric soils found outside of a wetland indicate that the area was once a wetland that has been drained. Based on a list of hydric soils maintained by NRCS, the hydric soils of the UTRLA Watershed were identified and are mapped in Figure 10. The hydric soils in the UTRLA Watershed tend to occur around waterbodies. However, by comparing the hydric soils to the current potential wetlands of the watershed identified later in section 2.5 on the NWI map (Figure 23), there are more hydric soils present than potential wetlands. This indicates that the UTRLA Watershed has been highly artificially drained, especially around Big Lake, south of Loon Lake, in the central portion of the watershed (between Loon and Big Lakes), and around the Crane Lake Inlet. These drained areas are highly agricultural except around Big Lake, which is predominately residential.

2.3 TOPOGRAPHY

The topography of the UTRLA Watershed is described as morainal topography with gently rolling hills and irregular mounds and ridges as a result of glacial drift. Based on elevations from Google Earth®, the lowest point in the watershed is approximately 895 feet where the Tippecanoe River exits the UTRLA Watershed, while the highest elevation is approximately 975 feet in the southern most reaches of the watershed south and east of Goose Lake. Figures 11 and 12 show watershed topography and Figure 13 shows the typical landscape of the watershed.

Table 1. Soil Associations in the UTRLA Watershed (NRCS SSURGO 2005 Soils Data)

Association	Characteristics
Blount-Glynwood-Morley	Deep or moderately deep to dense till, moderately to poorly drained soils "formed in a thin layer of loess and underlying till," on ground moraines and end moraines.
Houghton-Adrian-Carlisle	Deep, depressional and nearly level, very poorly drained, organic soils on lake plains, outwash plains and till plains.
Hoytville-Nappanee-Blount	Nearly level to gently sloping, poorly drained and somewhat poorly drained soils that have dominantly fine textured subsoil; on lake plains and till plains.

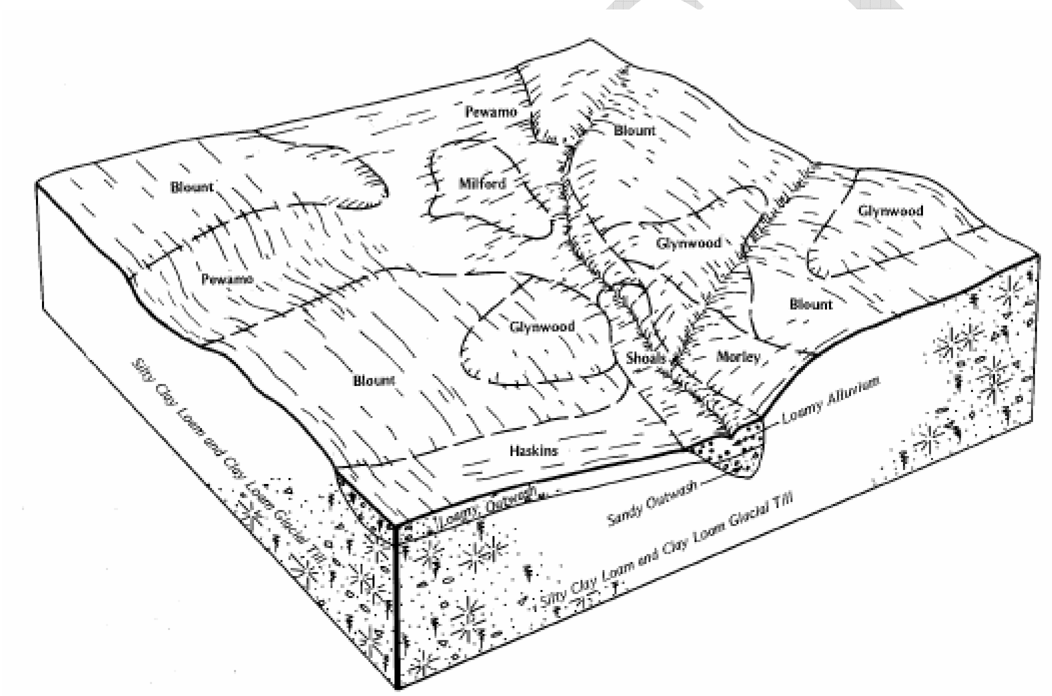


Figure 5. Pattern of soils and underlying material in Blount-Glynwood-Morley association (USDA Soil Survey)

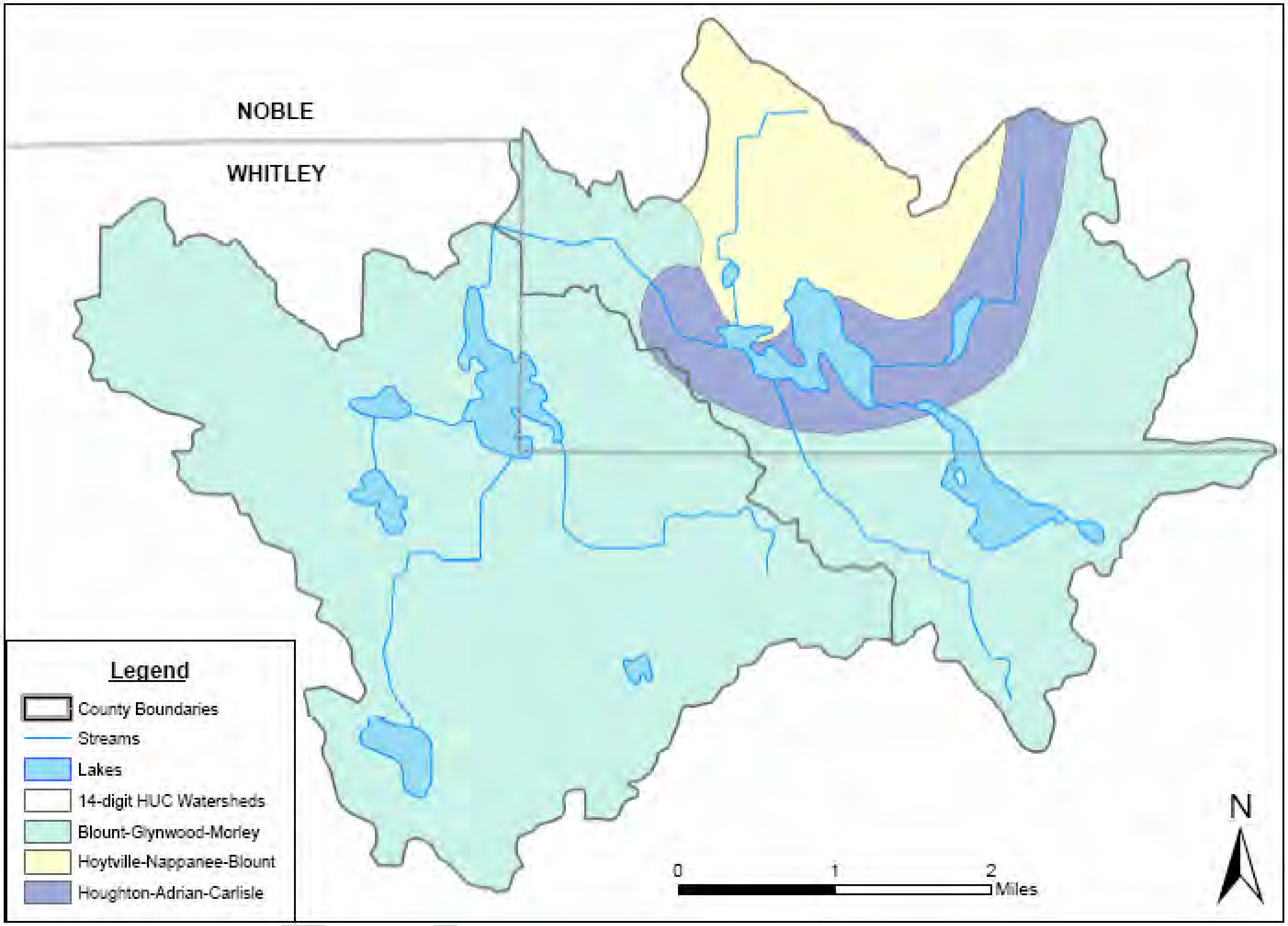


Figure 6. Soil Associations of the UTRLA Watershed (NRCS STATSGO 2005 Soils Data)

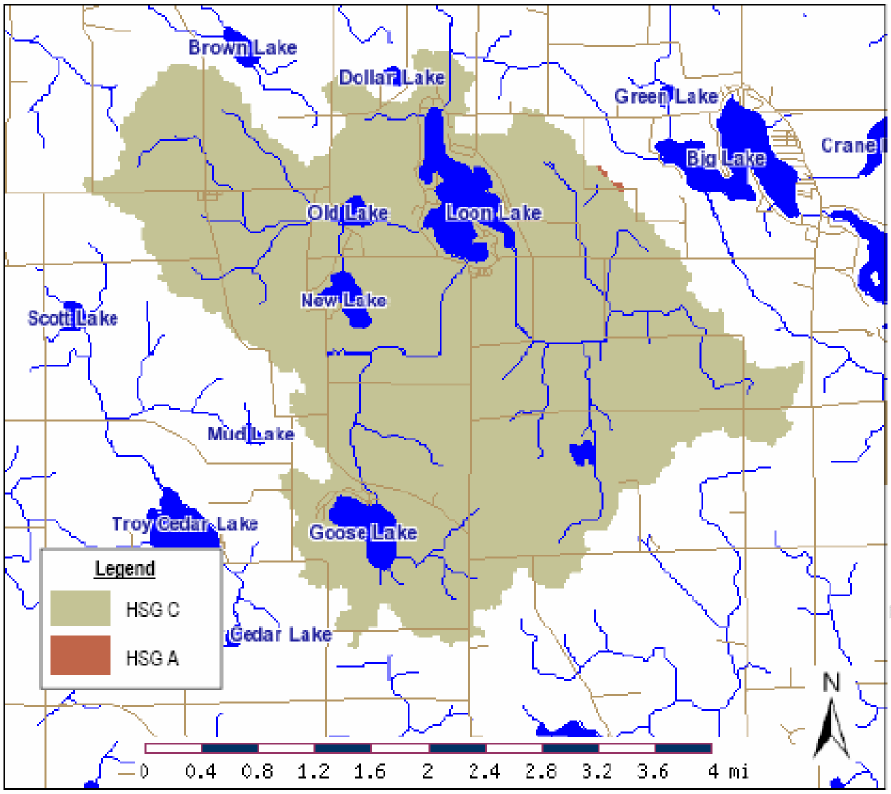


Figure 7. Hydrologic Soil Groups Map (HYMAPS-OWL)

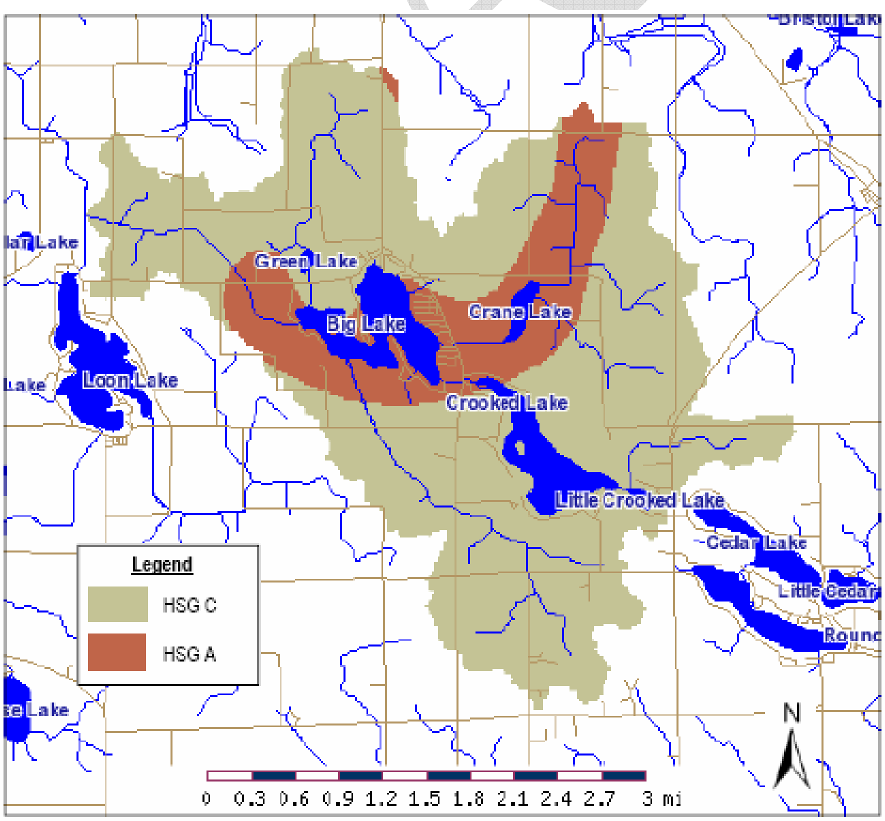


Figure 8. Hydrologic Soil Groups Map (HYMAPS-OWL)

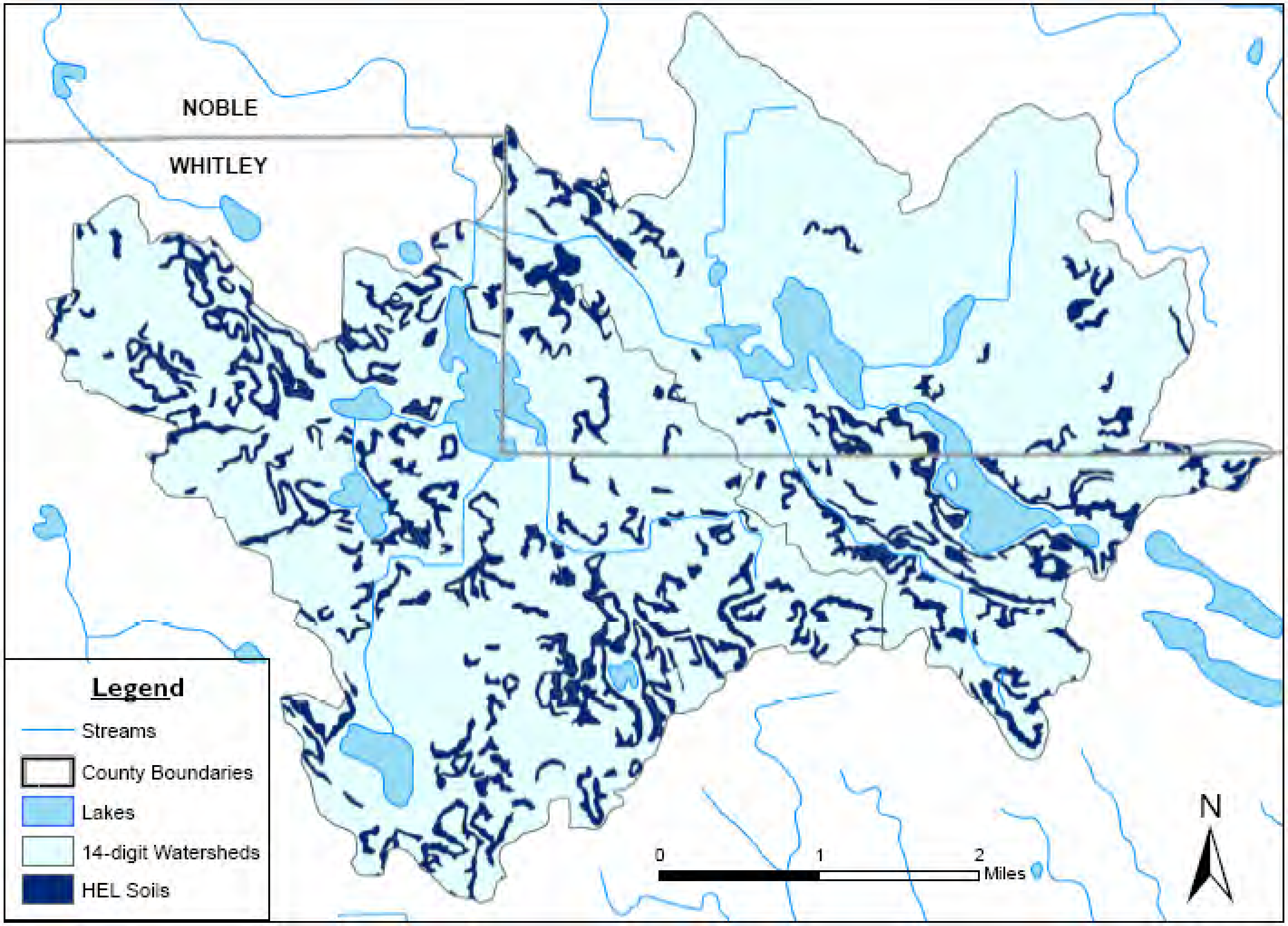


Figure 9. HEL Soils of the UTRLA Watershed (NRCS SSURGO)

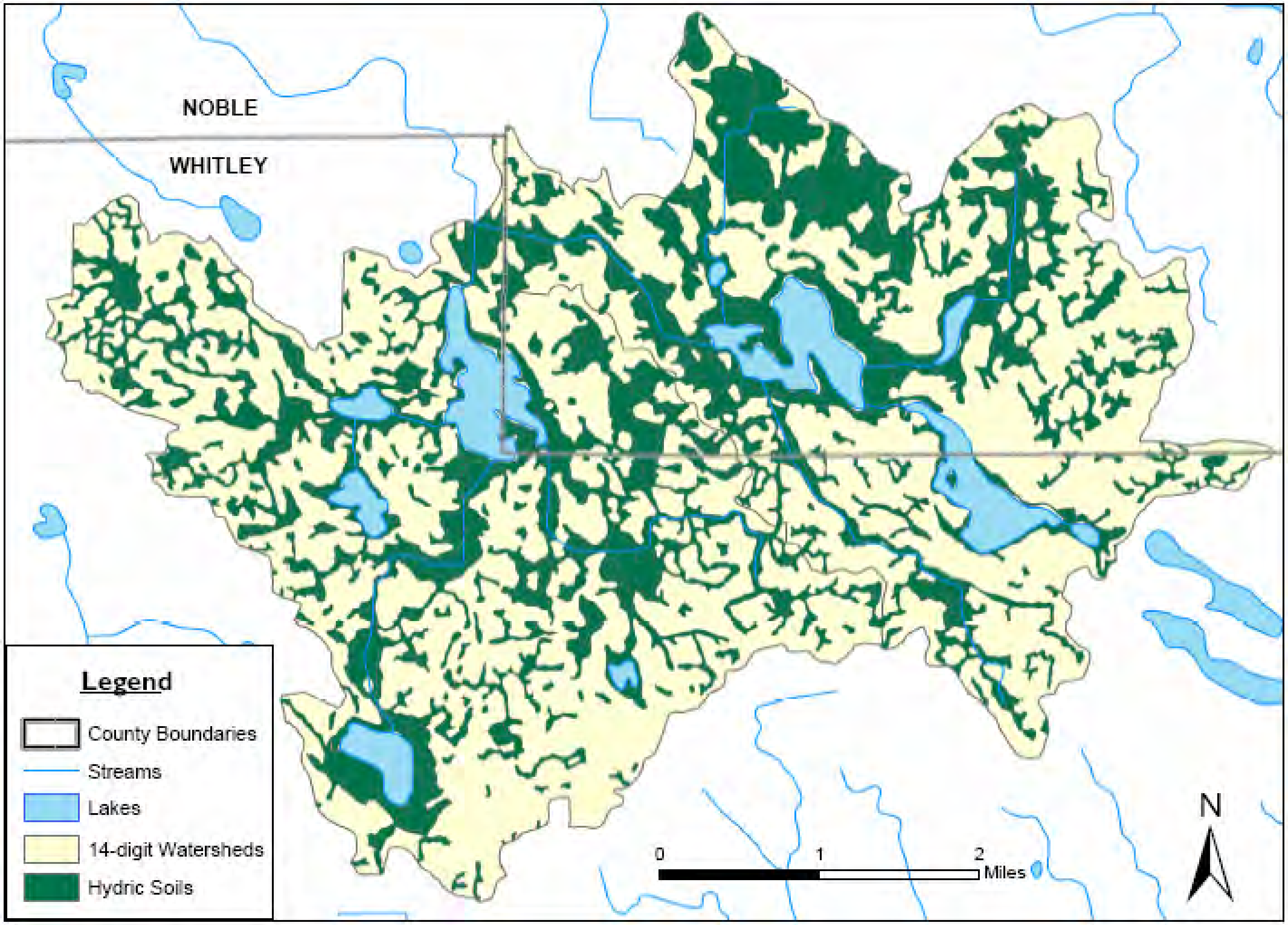


Figure 10. Hydric Soils of the UTRLA Watershed (NRCS SSURGO)

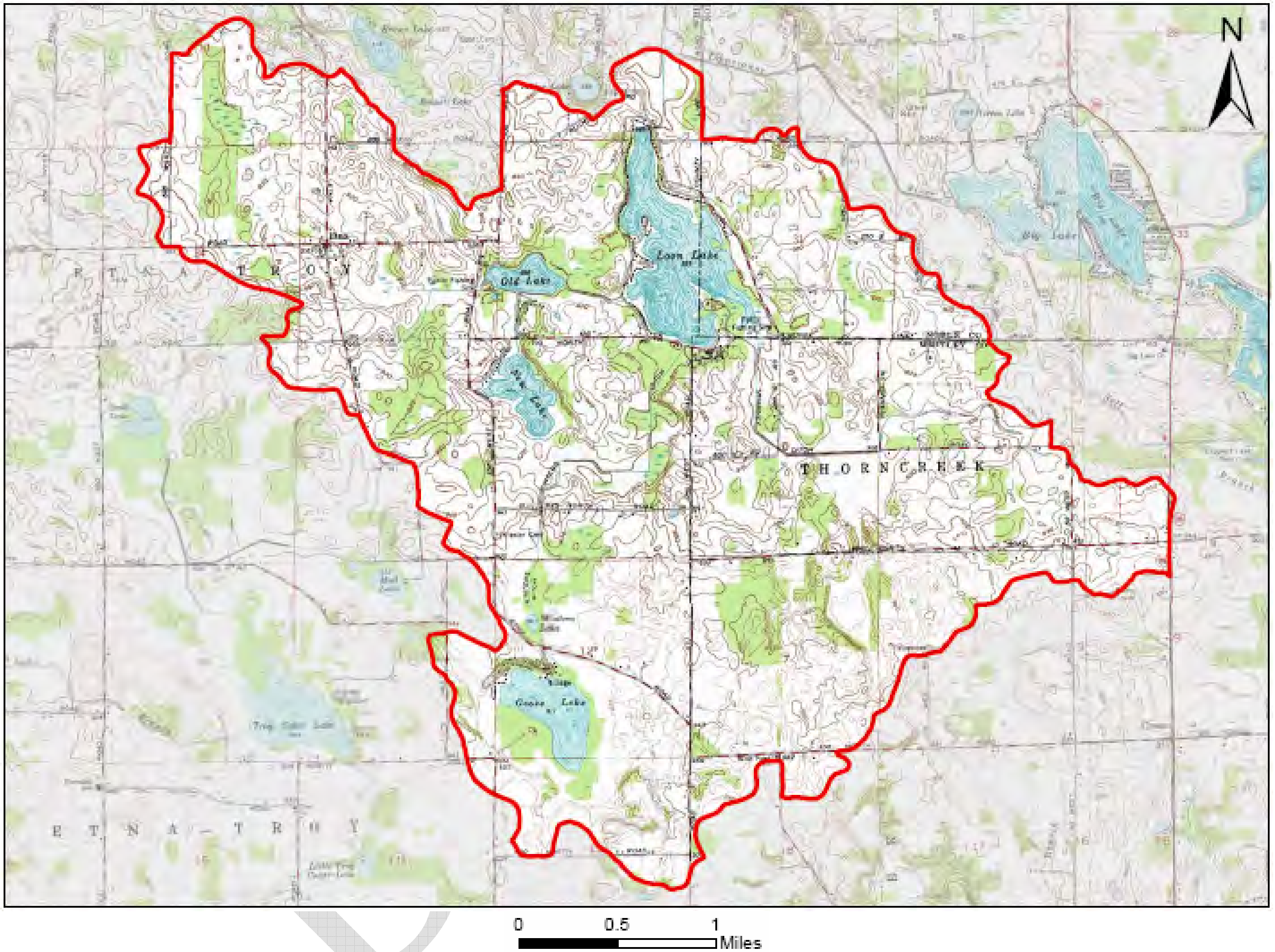


Figure 11. USGS Topographic Map of Loon Lake – Goose Lake/Old Lake Watershed

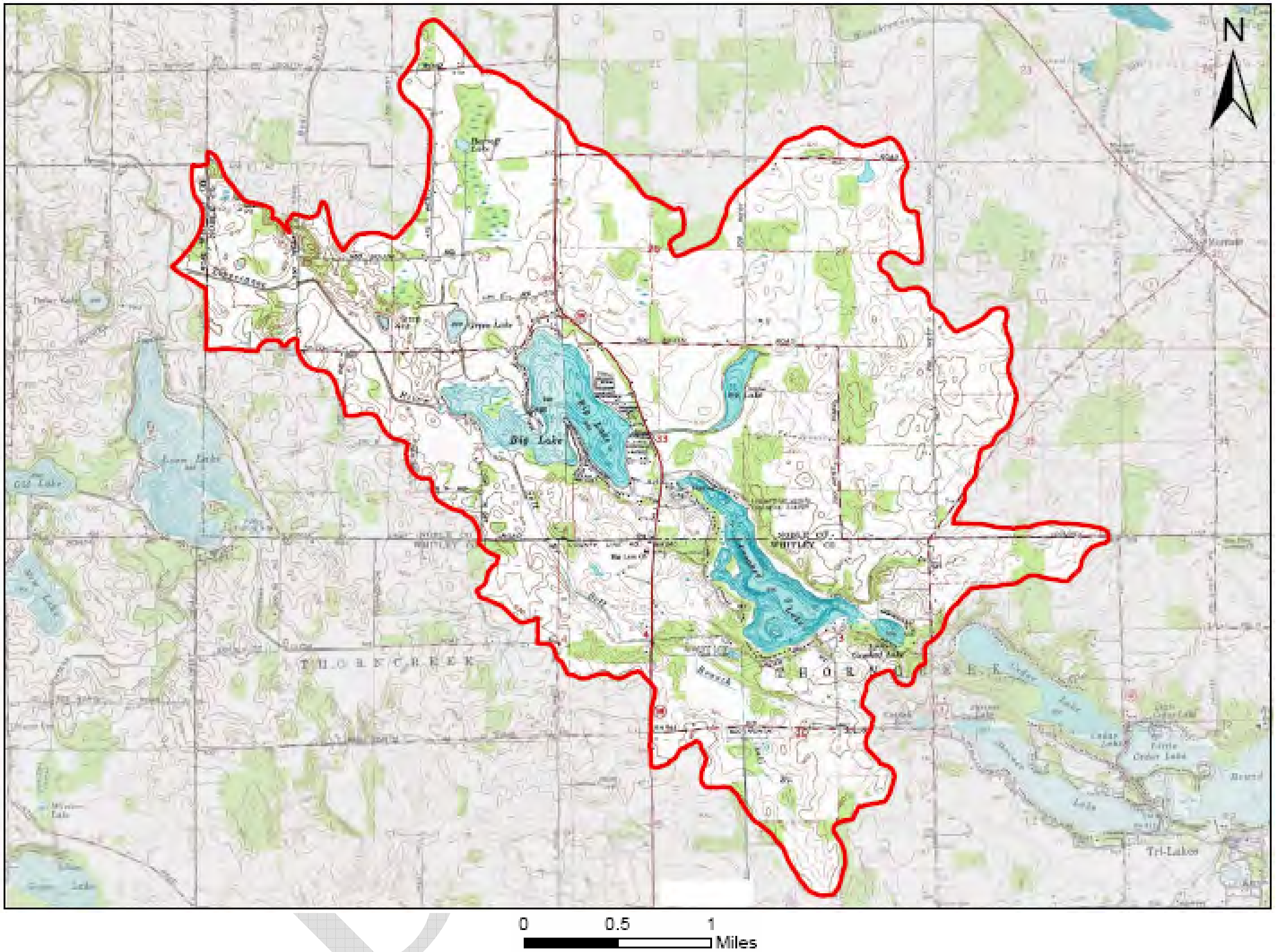


Figure 12. USGS Topographic Map of Tippecanoe River – Crooked Lake/Big Lake Watershed

Figure 13. Typical Landscape of the UTRLA Watershed

2.4 UTRLA SUBWATERSHEDS

The UTRLA Watershed consists of two 14-digt HUC watersheds, the Loon Lake – Goose Lake/Old Lake Watershed (HUC 05120106010020) and the Tippecanoe River – Crooked Lake/Big Lake Watershed (HUC 05120106010010), and is located within the 8-digit HUC Tippecanoe River Watershed (HUC 05120106). The UTRLA Watershed was broken down into 13 smaller subwatersheds for the purposes of this study. The subwatersheds are listed in Table 2 and shown on Figure 14.

Table 2. Subwatershed Areas

Sub-Watershed	Area (Acres)
A	1289
B	257
C	869
D	297
E	1947
F	2600
G	841
H	1367
I	1306
J	740
K	214
L	735
M	1086

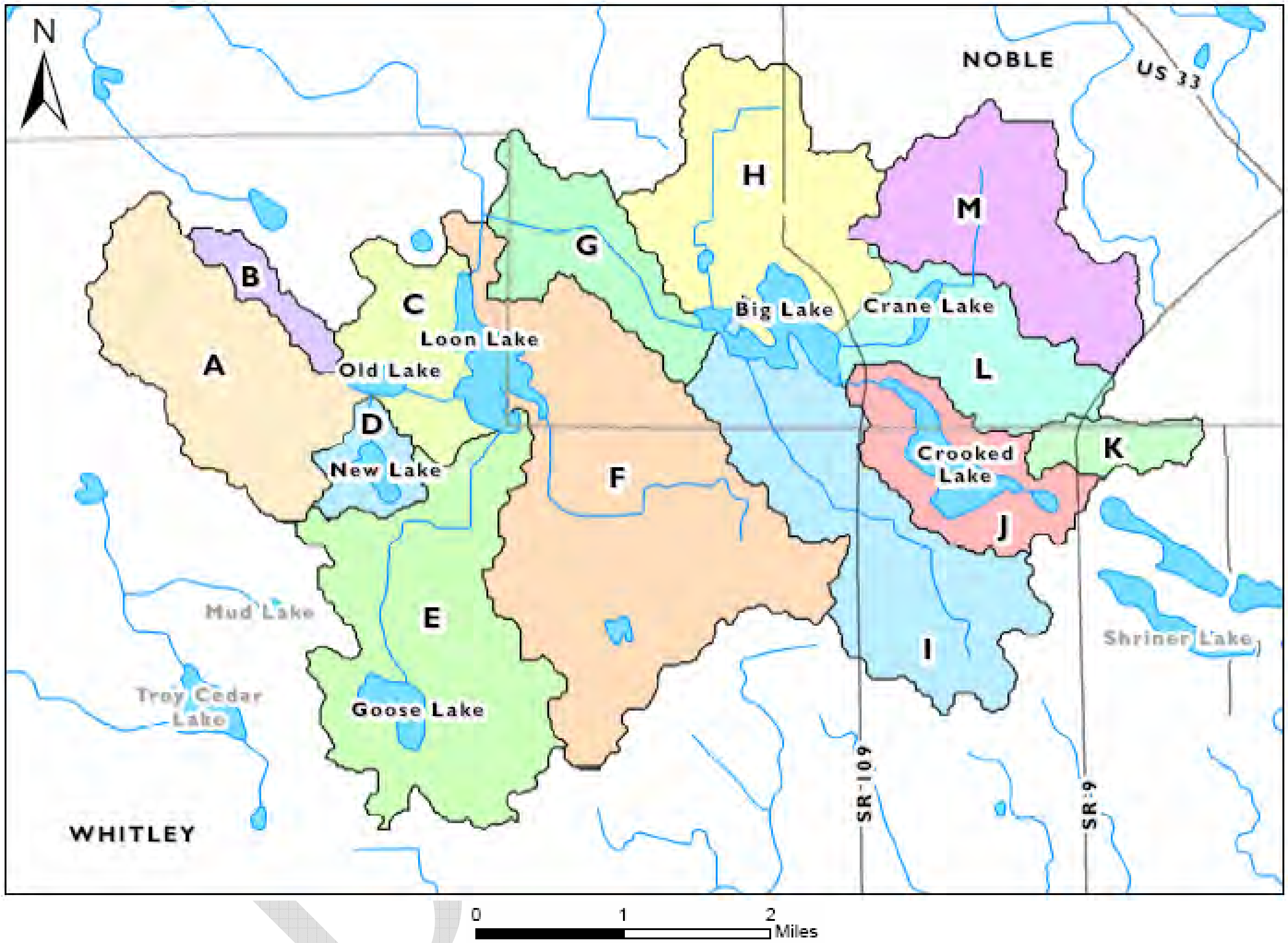


Figure 14. Subwatersheds within the UTRLA Watershed

Subwatershed A

Subwatershed A consists of 1,289 acres that drain into a tributary to Old Lake (Old Lake South Inlet as designated later in the study). **Figure 15** shows the sign for the Old Lake public access, which is located in this subwatershed. Row crops make up the primary land use of the watershed (65%), with forested land (21%) as the second largest land use. Subwatershed A is composed entirely of the Blount-Glynwood-Morley soil association and of HSG C, indicating poor drainage. This subwatershed contains two open regulated drains and six regulated tile drains. The subwatershed contains approximately 23% of HEL soils and a greater amount of hydric soils than potential wetlands. All of the above indicates that many of the wetlands have been artificially drained for agricultural cultivation.

Figure 15. Old Lake Sign Photo

Subwatershed B

Subwatershed B also contains a tributary to Old Lake (Old Lake North Inlet). This tributary drains only 257 acres that consist of 65 percent row crops and 16 percent forested land as the two primary land uses. Subwatershed B is also composed entirely of the Blount-Glynwood-Morley soil association and of HSG C, which indicates poor drainage. This subwatershed contains one open regulated drain and one closed regulated drain. Subwatershed B is comprised of 44% HEL soils and a large amount of hydric soils. Some potential wetlands remain in this subwatershed; however, it appears that many wetlands have been artificially drained for agricultural production.

Subwatershed C

Subwatershed C contains the majority of Old Lake, the entire western shore of Loon Lake, the Loon Lake north and south inlets, and the inlet between Old and Loon Lakes. The predominant land use of this 869 acre watershed is open water (35%), with the remainder of the land uses divided almost evenly between row crops (17%), residential (17%), grass and pasturelands (16%), and forested land (12%). The moderately to poorly drained soils characteristic of both the Blount-Glynwood-Morley soil association and HSG C cover the entire watershed. This subwatershed contains two open and two closed regulated drains, and approximately 17% HEL soils and a moderate amount of hydric soils. Based on a comparison of hydric soils to current potential wetlands, it appears that this subwatershed is far less artificially drained than most of the other subwatersheds of the UTRLA Watershed.

Subwatershed D

Subwatershed D contains 297 acres, which includes all of New Lake and the tributary that flows from New Lake to Old Lake. **Figure 16** depicts the typical landscape of subwatershed D with New Lake in the background. Row crops are the predominate land use (43%), with forested land (19%) and open water (18%) the next largest land uses. Subwatershed D is made up entirely of the moderately to poorly drained Blount-Glynwood-Morley soil association and HSG C. This subwatershed contains no regulated drains, 19% HEL soils and a moderate amount of hydric soils relative to its size. Few potential wetlands are located within this subwatershed, indicating that artificial drainage is occurring in this subwatershed.

Figure 16. New Lake Photo

Subwatershed E

Subwatershed E is comprised of 1,947 acres that drain into Goose Lake, Winters Ditch, and Loon Lake. All of Goose Lake and Winters Ditch as well as the southern shore of Loon Lake is located within the boundaries of this subwatershed. **Figure 17** shows the sign for the Goose Lake public access, which is located within this subwatershed. Row crops comprise the large majority of the watershed (68%) with forested land (13%) as the second largest land use. The Blount-Glynwood-Morley soils association and HSG C cover the entire subwatershed, indicating poor drainage. This subwatershed contains two open and ten closed regulated drains. This subwatershed contains 13% HEL soils, mostly located in the southern portion of the watershed. High concentrations of hydric soils are located around Goose Lake and along Winters Ditch, with lower concentrations spread throughout the rest of the subwatershed. The southwestern, southern, and eastern shores of Goose Lake largely consist of potential wetlands, while there are few wetlands along the northern shore which has been developed with residences indicating this area has been artificially drained or filled in. The areas of hydric soils along Winters Ditch have a few large potential wetlands, but appear to be largely artificially drained as does the remainder of the watershed.

Figure 17. Goose Lake Sign Photo

Subwatershed F

2,600 acres that drain into Friskney Ditch, the entire eastern shore of Loon Lake, and Schaefer Ditch comprise Subwatershed F. A photo of Loon Lake is included as Figure 18. The large majority of this subwatershed is made up of row crops (73%) with forested land (16%) making up the second largest land use. The soils of Subwatershed F, the Blount-Glynwood-Morley soil association and HSG C, are characterized by moderate to poor drainage. Two open and twenty closed regulated drains are located within this subwatershed. The HEL soils in this subwatershed total 16%, mostly in southern portion of the subwatershed, while the rest of the watershed has limited HEL soils. Highly concentrated areas of hydric soils occur along the eastern shore of Loon Lake, along Friskney Ditch, and in the eastern portion of the watershed. There are very few potential wetlands located in this subwatershed, indicating that old wetlands were artificially drained or filled along the eastern shore of Loon Lake, and were artificially drained into or by Friskney Ditch and in the eastern portion of the subwatershed.

Figure 18. Loon Lake Photo

Subwatershed G

Subwatershed G is comprised of 841 acres of land that drain into the Tippecanoe River, which drains the entire UTRLA Watershed and conveys water out of the UTRLA Watershed. This subwatershed is comprised predominately of row crops (60%) with open water (16%) as the second largest land use. One open and one closed regulated drain is located in this subwatershed. The majority of Subwatershed G is made up of the Blount-Glynwood-Morley soil association and HSG C, which are characterized as poorly drained soils. An area west of Big Lake is composed of the Houghton-Adrian-Carlisle soil association, which is characterized by very poorly drained soils. However, this same area contains HSG A, which is classified as well to excessively drained soils. This indicates that this area has been significantly artificially drained. This subwatershed also contains a large amount of hydric soils concentrated along the Tippecanoe River and around Big Lake; however very few potential wetlands are located in these areas. This also indicates the widespread use of artificial drainage. This subwatershed contains approximately 27% HEL soils, which are mostly located in the northern portion of the watershed.

Subwatershed H

Subwatershed H is comprised of Haroff Branch, Green Lake, Stuckman Ditch, and the northern shore of Big Lake which drain a total of 1,367 acres of land. A photo of Big Lake is included as Figure 19. The predominate land use is row crops (67%), while open water and forested land each make up 11% of the subwatershed. Subwatershed H contains four open and four closed regulated drains. The Hoytville-Nappanee-Blount soil association and HSG C, which are poorly drained, almost entirely comprise this subwatershed. A small area in the northern portion of the watershed and another small area north of Big Lake are made up the Houghton-Adrian-Carlisle association and HSG A. Again, this indicates the heavy usage of artificial drainage. This subwatershed contains 4% of HEL soils, but is predominately comprised of hydric soils. Very few potential wetlands are identified in this subwatershed, once again indicating that the majority of the watershed is artificially drained.

Figure 19. Big Lake Photo

Subwatershed I

Sell Ditch and the southern shore of Big Lake are located within Subwatershed I, which drains 1,306 acres of predominately agricultural row crops (75%). Forested land (13%) is the second largest land use. Only one open and no closed regulated drains are located within this subwatershed. Subwatershed I is largely made up of the Blount-Glynwood-Morley association and HSG C, which are both poorly drained. A small area just south of Big Lake is composed of the Houghton-Adrian-Carlisle association and HSG A. As explained before, this indicates the heavy usage of artificial drainage. This subwatershed contains 34% of HEL soils, and a large amount of hydric soils concentrated along the southern shore of Big Lake and along Sell Ditch. Currently several large potential wetlands remain along the southern shore of Big Lake; however, the land along Sell Ditch is relatively void of wetlands. This also indicates that the land draining into Sell Ditch is highly artificially drained.

Subwatershed J

Subwatershed J contains Crooked Lake, Little Crooked Lake, the tributary between Crooked and Big Lakes, the Crooked Lake west and south inlets, and an inlet that drains into Little Crooked Lake. A photo of Crooked Lake is included as Figure 20. The primary land use of the 740 acre subwatershed is forested land (34%), with open water (31%) and residential (22%) as the next largest land uses. A 145 acre nature preserve, the IPFW Crooked Lake Biological Station, and a nine hole golf course are all located within this subwatershed. Only one open and no closed regulated drains are located in Subwatershed J. The majority of this subwatershed is composed of the poorly drained Blount-Glynwood-Morley soil association and HSG C. However, the area between Big Lake and Crooked Lake is made up of the very poorly drained Houghton-Adrian-Carlisle soil association and the well drained HSG A, indicating that the area likely uses large amounts of artificial drainage. The subwatershed contains 31% of HEL soils mostly located in the portion of the subwatershed to the south of Crooked Lake, which contains some of the highest elevations in the UTRLA Watershed. A relatively low amount of hydric soils and potential wetlands are located within this subwatershed.

Figure 20. Crooked Lake Photo

Subwatershed K

Subwatershed K contains 214 acres of land that drain into Farm Ditch, which eventually inlets into Little Crooked Lake. The predominate land use is row crops (69%) with forested land (20%) as the second largest land use. There are no regulated drains within this subwatershed. Subwatershed K is entirely composed of the poorly drained Blount-Glynwood-Morley soil association and HSG C. This subwatershed contains 54% HEL soils and a small amount of hydric soils, and also contains very few potential wetlands. Therefore, artificial drainage is likely used less frequently in this subwatershed.

Subwatershed L

735 acres of land comprising Subwatershed L drain into Crane Lake, a portion of the Crane Lake Inlet, and the inlet between Crane Lake and Big Lake. A photo of Crane Lake is included as Figure 21. Row crops (72%) and forested land (14%) are the two predominate land uses in this subwatershed, which contains one open and six closed regulated drains. Subwatershed L is made up of the poorly drained Blount-Glynwood-Morley soil association and HSG C, the very poorly drained Houghton-Adrian-Carlisle soil association, and the well drained HSG A. This indicates that this subwatershed is likely predominantly artificially drained. The subwatershed is composed of 14% HEL soils and large amounts of hydric soils. Potential wetlands remain around Crane Lake, however the remainder of the potential watershed contains very few wetlands also indicating the predominate use of artificial drainage.

Figure 21. Crane Lake Photo

Subwatershed M

Subwatershed M contains the northern portion of the Crane Lake Inlet, which drains 1,086 acres. The vast majority of this land is planted to row crops (92%), while only 4% is forested land. One open and one closed regulated drain is located within this subwatershed. The southeastern portion of Subwatershed M is composed of the poorly drained Blount-Glynwood-Morley association and HSG C. The northeastern portion of the subwatershed is made up of the poorly drained Hoytville-Nappanee-Blount soil association and HSG C. The central portion of the subwatershed is composed of the very poorly drained Houghton-

Adrian-Carlisle association and HSG A, indicating this area is likely predominantly artificially drained. This subwatershed contains only 11% HEL soils, but very large amounts of hydric soils with concentrations around the Crane Lake Inlet. There are almost no potential wetlands located along the Crane Lake Inlet, and only a few located in the rest of the watershed. This also indicates the likely presence of artificial drainage systems.

2.5 HYDROLOGY OF THE UTRLA WATERSHED

There are approximately 875 acres of lakes, 110,240 feet of streams and drainage ditches, and 1,739 acres of potential wetlands (Tables 3 – 5 and Figures 22 and 23) within the UTRLA Watershed. Wetlands have a natural ability to filter pollutants out of water before it enters a ditch or stream. Streams and ditches range from 1st order to 2nd order based on USGS 1:24,000 scale topographic maps (Table 4). According to the Indiana Geological Survey, the area heavily relies on groundwater as the drinking water source; most utilizing private wells.

Waterbodies in the UTRLA Watershed may be considered "waters of the US". Therefore, permits will be required for crossing, outletting or working within the easement of the waterbody. The required permits include US Army Corps of Engineers, Section 404; and Indiana Department of Environmental Management, Water Quality Certification. If the action involves the floodway of a waterbody a Construction in a Floodway permit from the Indiana Department of Natural Resources, Division of Water will be required. Figure 24 shows the floodplains in the UTRLA Watershed. Furthermore, the waterbody may be classified on the county level as regulated or legal drains. The regulated drains of the UTRLA Watershed are displayed in Figures 25 and 26. Permits from individual county surveyor's offices will be needed for any actions on a county regulated drain.

Table 3. Lake Areas

Lake	Area (Acres)	14-digit Watershed
Goose	84	Loon
Old	32	Loon
New	50	Loon
Loon	222	Loon
Unnamed	16	Loon
Big	228	Tippecanoe
Crane	28	Tippecanoe
Crooked and Little Crooked	206	Tippecanoe
Green	9	Tippecanoe
Total	875	

Table 4. Stream Lengths and Orders

Stream or Ditch	Length (ft.)	Order
Crume Ditch	3207	1st
Friskney T Ditch	13,450	1st
Haroff Branch	9,260	2nd
Pence O	1,315	1st
Sell Branch	13,727	1st
Schaefer	2,326	1st
Stangland #11	2,679	1st
Stangland #31	12,818	1st
Stangland #33	6,248	2nd
Stangland #418	7,132	1st
Stuckman Ditch	2,116	1st
Tippecanoe River	9,791	1st
Turner Branch	2,945	1st
Tributary between Crane and Big	2,547	1st
Tributary between Crooked and Big	1,150	1st
Tributary between Old and New	1,861	1st
Tributary to Crane	2,116	1st
Tributary to Crooked (NW)	9,67	1st
Tributary to Crooked (W)	353	1st
Tributary to Crooked (SW)	1,047	1st
Tributary to Crooked (NE)	792	1st
Tributary to Friskney T	3,127	1st
Tributary to Goose	1,083	1st
Tributary to Little Crooked (E)	823	1st
Tributary to Little Crooked (N)	3,141	1st
Tributary to Stangland #33	1,499	1st
Tributary to Sell Ditch	1,237	1st
Winters Ditch	1,483	1st
TOTAL	110,240	

Table 5. Wetland Types and Areas

Wetland Type	Description	Acres
L1UBH	Lacustrine, Limenetic, Unconsolidated Bottom, Permanently Flooded	774
PAB/UBG	Palustrine, Aquatic Bed/Unconsolidated Bottom, Intermittently Exposed	4
PEM/FO1C	Palustrine, Emergent/Forested, Broad-Leaved Deciduous, Seasonally Flooded	3
PEM/SS1C	Palustrine, Emergent/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	27
PEM/SS1CD	Palustrine, Emergent/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded, Partially Drained/Ditched	10
PEMA	Palustrine, Emergent, Temporarily Flooded	10
PEMAD	Palustrine, Emergent, Temporarily Flooded, Partially Drained/Ditched	1
PEMB	Palustrine, Emergent, Saturated	10
PEMBD	Palustrine, Emergent, Saturated, Partially Drained/Ditched	7
PEMC	Palustrine, Emergent, Seasonally Flooded	100
PEMCD	Palustrine, Emergent, Seasonally Flooded, Partially Drained/Ditched	30
PEMF	Palustrine, Emergent, Semipermanently Flooded	10
PEMU	Palustrine, Emergent, Unkown	101
PEMUD	Palustrine, Emergent, Unkown, Seasonally Flooded, Partially Drained/Ditched	83
PFO/SS1A	Palustrine, Forested/Scrub-Shrub, Broad-Leaved Deciduous, Temporarily Flooded	2
PFO/SS1C	Palustrine, Forested/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	18
PFO1/EMC	Palustrine, Forested, Broad-Leaved Deciduous/Emergent, Seasonally Flooded	7
PFO1A	Palustrine, Forested, Broad-Leaved Deciduous, Temporarily Flooded	48
PFO1C	Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded	368
PFO1CD	Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded, Partially Drained/Ditched	2
PSS/FO1C	Palustrine, Scrub-Shrub/Forested, Broad-Leaved Deciduous, Seasonally Flooded	7
PSS1/EMC	Palustrine, Scrub-Shrub, Broad-Leaved Deciduous/Emergent, Seasonally Flooded	3
PSS1B	Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Saturated	1
PSS1C	Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	34
PUB/EMF	Palustrine, Unconsolidated Bottom/Emergent, Semipermanently Flooded	18
PUBF	Palustrine, Unconsolidated Bottom, Semipermanently Flooded	5
PUBFX	Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated	2
PUBG	Palustrine, Unconsolidated Bottom, Intermittently Exposed	12
PUBGH	Palustrine, Unconsolidated Bottom, Intermittently Exposed, Diked/Impounded	4
PUBH	Palustrine, Unconsolidated Bottom, Permanently Flooded	31
PUBHH	Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded	4
PUBHX	Palustrine, Unconsolidated Bottom, Permanently Flooded, Excavated	3
TOTAL		1739

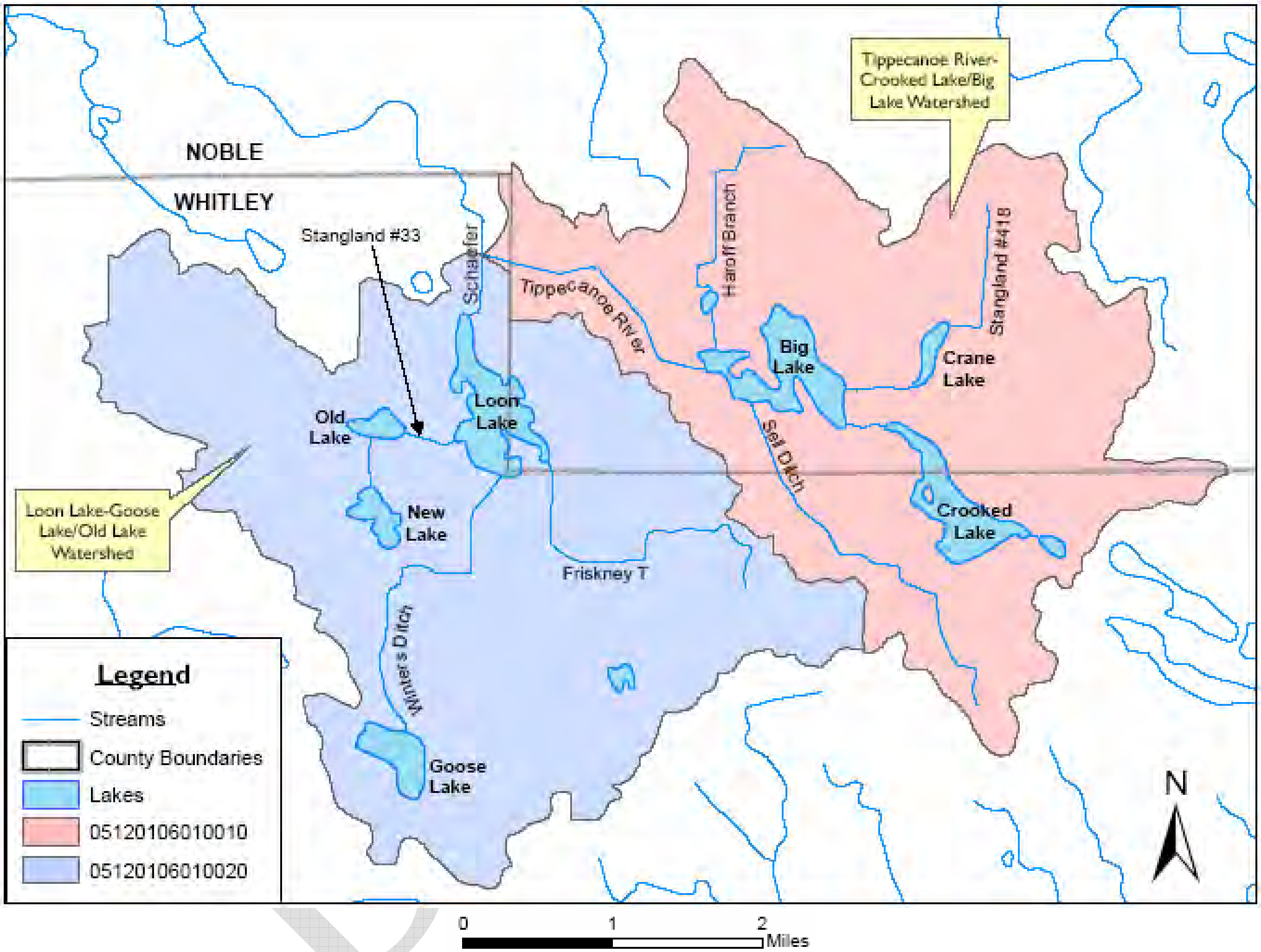


Figure 22. Lakes and Major Tributaries of the UTRLA Watershed

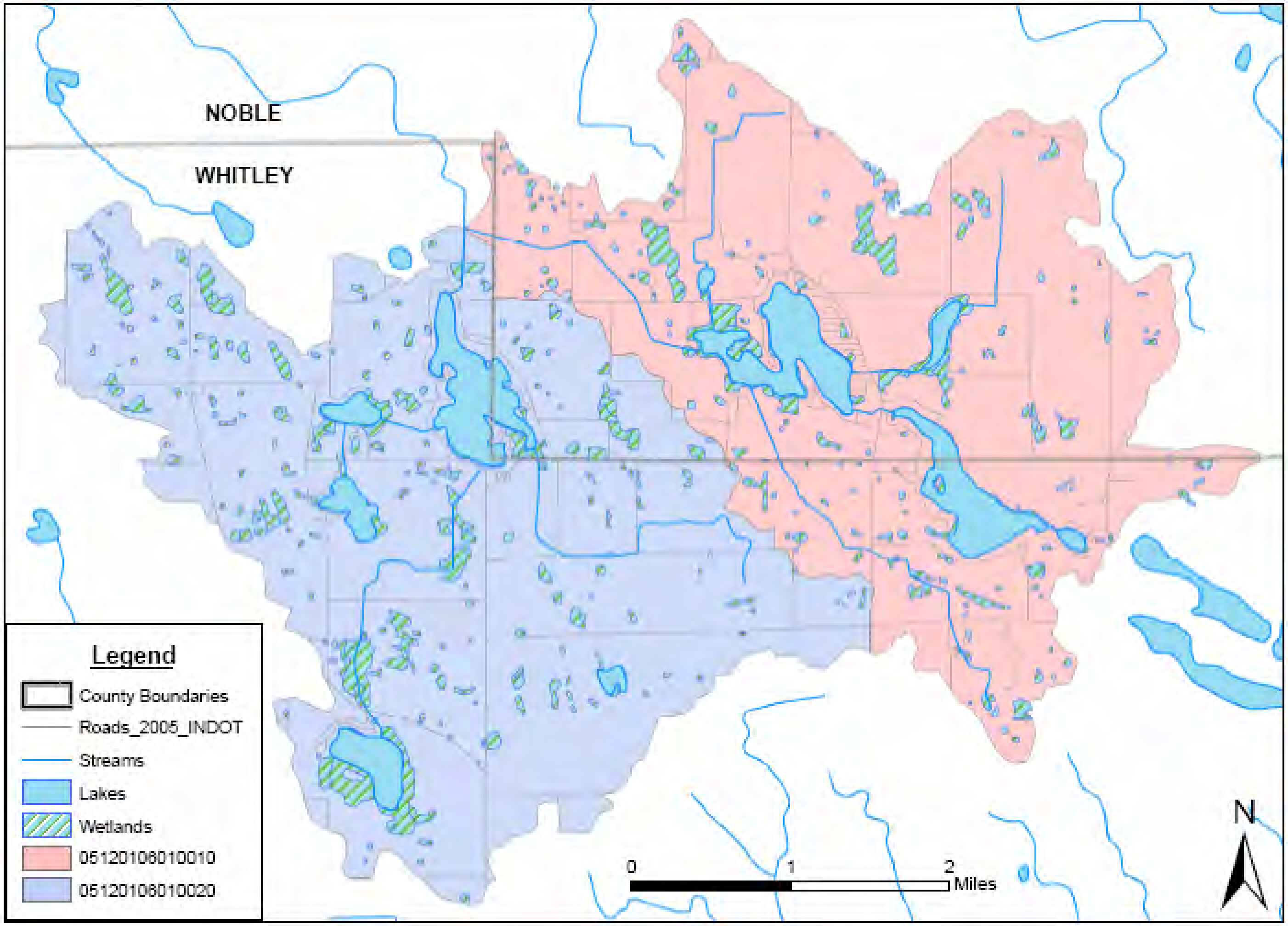


Figure 23. Wetlands in the UTRLA Watershed (National Wetlands Inventory)

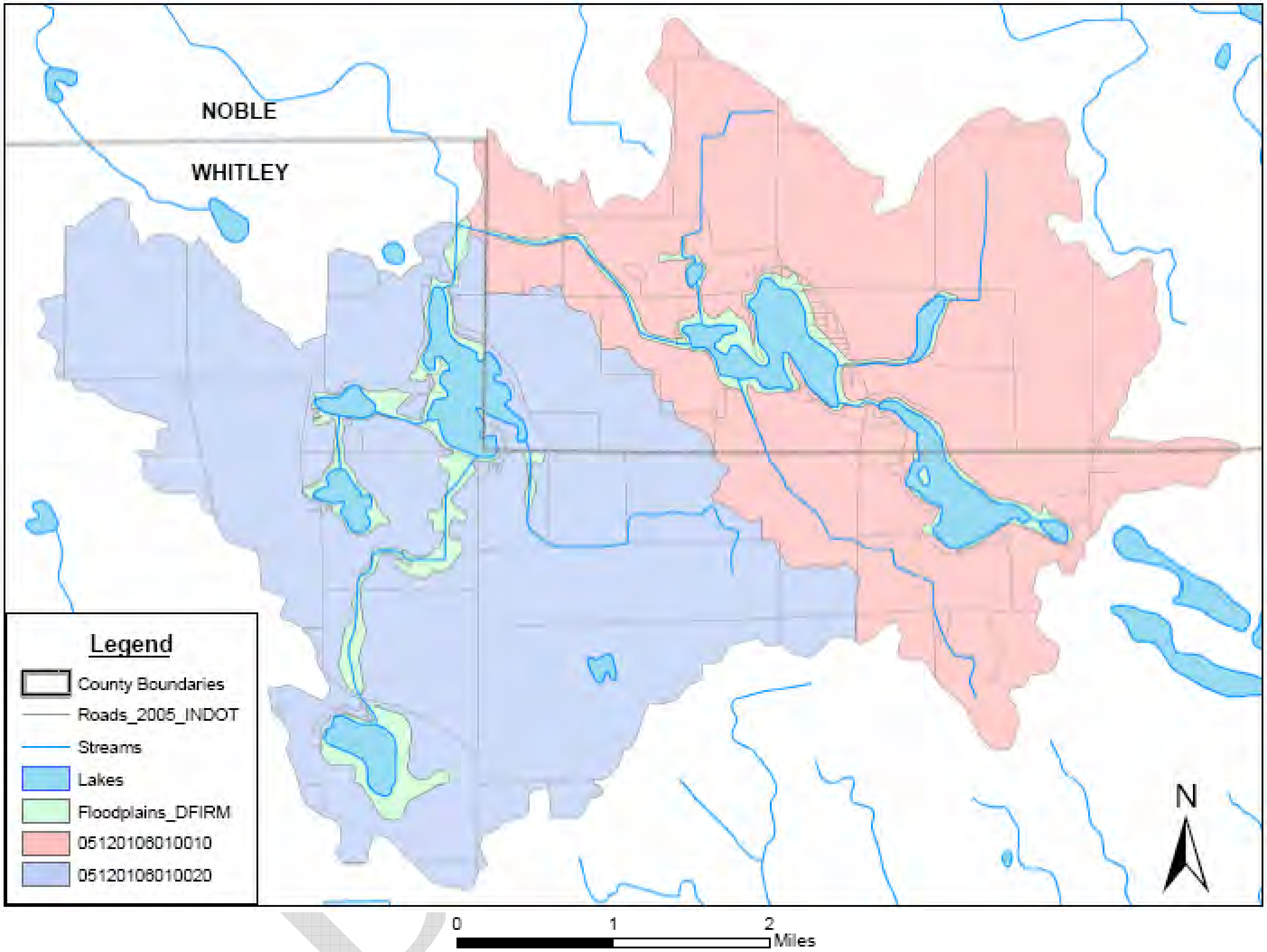


Figure 24. Floodplains in the UTRLA Watershed (FEMA – DFIRM)

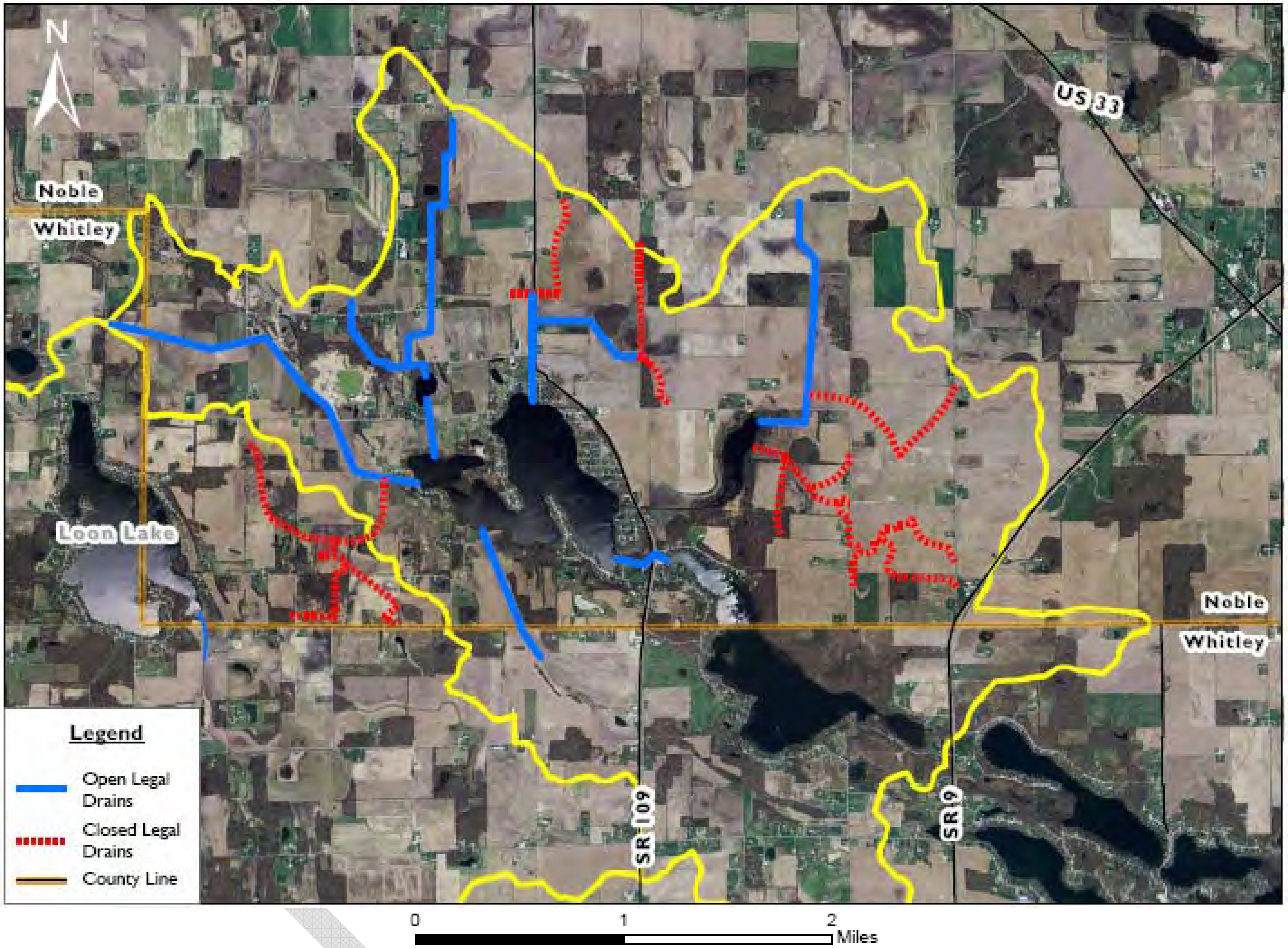


Figure 25. Regulated (Legal) Drains in Noble County (Noble County GIS)

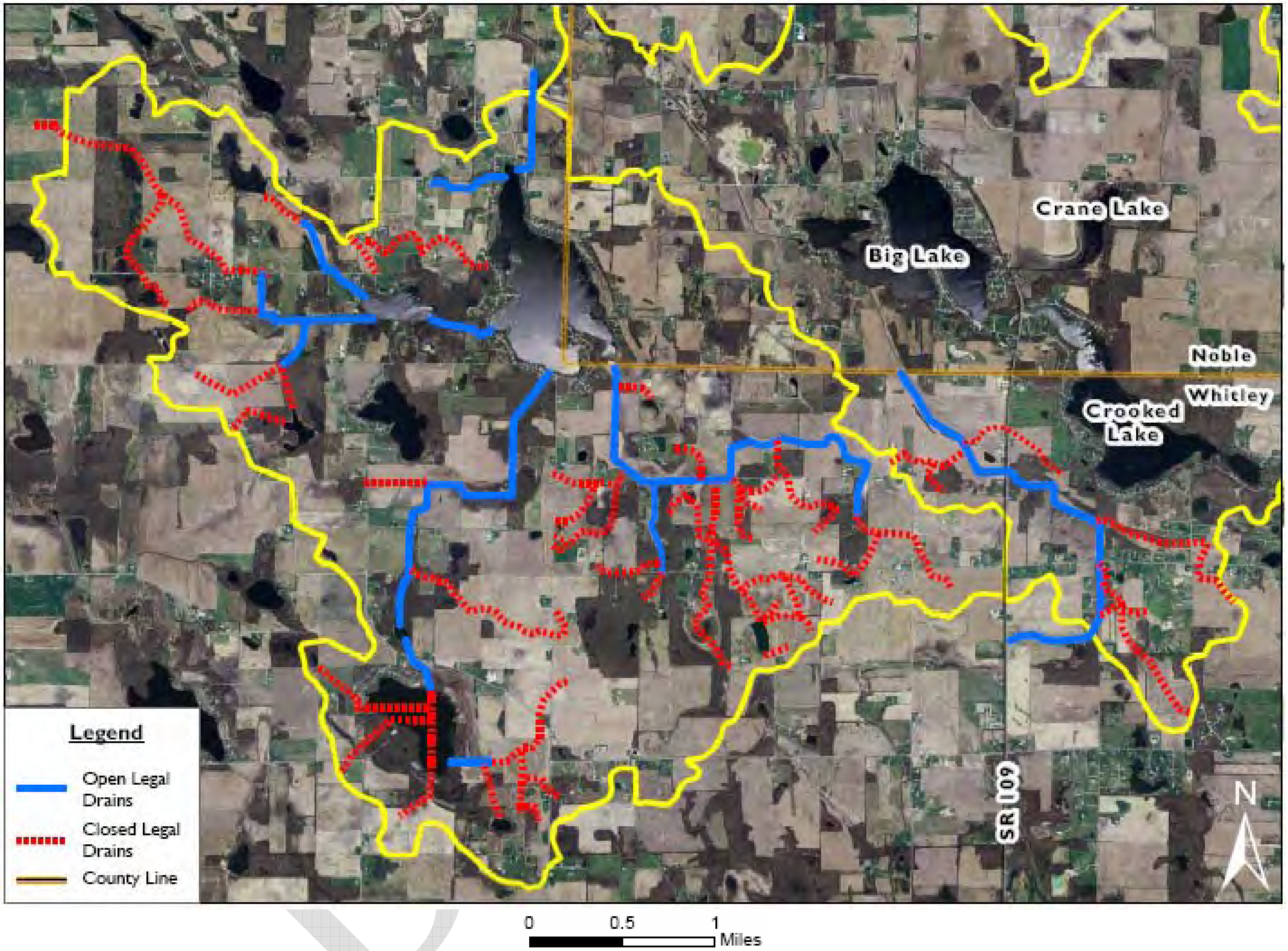


Figure 26. Regulated (Legal) Drains in Whitley County (Whitley County GIS)

2.6 CLIMATE

Noble and Whitley Counties have typical Midwest North American climates. The watershed receives an average of 36.5 inches of rainfall a year (City-Data, 2007). Based on information from City-Data, the average annual temperature for Columbia City is 48.8°F, with an average high temperature in July of 72°F and an average low temperature in January of 21°F (Figure 27).

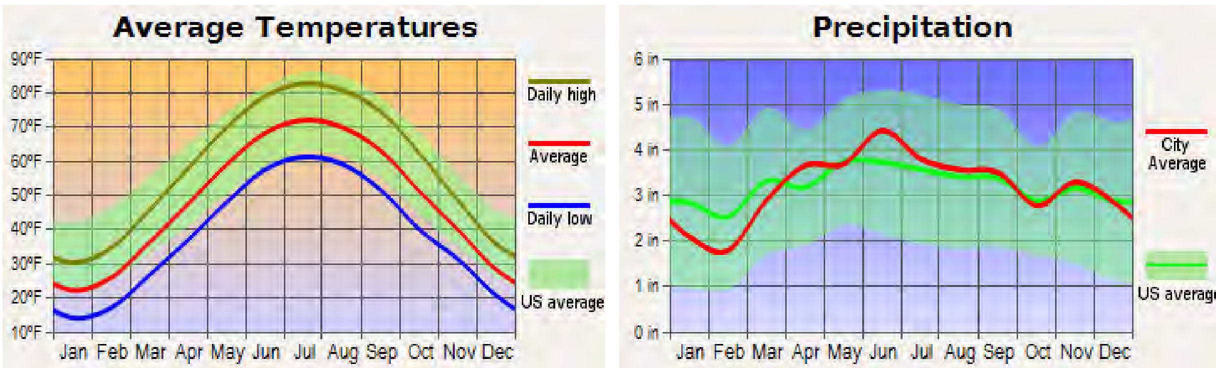


Figure 27. Average Temperatures and Precipitation for Columbia City, Indiana (City Data, 2007)

2.7 HISTORY OF THE UTRLA WATERSHED

The early inhabitants of the UTRLA Watershed were the Potawatomi Indians. The Potawatomi women planted and harvested corn, beans, squash, and tobacco and gathered wild rice and berries. The Potawatomi men fished and hunted deer, elk, and wild birds. The first white settlers arrived in the area in the 1820's or 1830's and drove the Potawatomi Indians from northern Indiana into the Osage River valley in Kansas. In the early 1840's, the first Amish people arrived to the area. Although the Amish have a stronghold in surrounding areas, there are currently few to no Amish living in the UTRLA Watershed. Following settlement, the UTRLA Watershed has been dominated by agricultural production and supports strong water recreation.

2.8 ENDANGERED SPECIES

The IDNR Division of Nature Preserves provides a Natural Heritage Datacenter for the documentation of state and federally listed endangered, threatened, and rare species (ETR). The IDNR serves to identify, protect, and manage significant natural areas and ETR species. Currently over 23,000 acres of dedicated Nature Preserves are located throughout the state. The preservation of natural communities supports species diversity and provides examples of historic conditions for recreational, educational, and scientific opportunities. The IDNR has compiled a list of all ETR species for each county in the State of Indiana and a copy of the Noble and Whitley County ETR Species List and Potential Habitat Table are included as Tables 6 and 7. There are a number of ETR species in Noble and Whitley Counties; however, a detailed study to determine if these species are present in the UTRLA Watershed was not performed.

Table 6. Nobel County Endangered, Threatened, and Rare Species

Species name	Common name	Federal	State	Typical Habitat
Insect: Lepidoptera (Butterflies & Moths)				
Euphydryas phaeton	Baltimore		SR	wet meadows
Lycaena dorcas dorcas	Dorcas Copper		SR	Edges of bogs, old brushy fields, open places near small streams
Pieris oleracea	Eastern Veined White		SE	wherever plants in the mustard family grow, fields, meadows
Fish:				
Coregonus artedi	Cisco		SSC	Open waters of lakes and large rivers
Amphibians				
Ambystoma laterale	Blue-spotted Salamander		SSC	deciduous and coniferous forests with sandy soils
Necturus maculosus	Common Mudpuppy		SSC	Aquatic; lakes, ponds, rivers, and streams.
Reptiles				
Clemmys guttata	Spotted Turtle		SE	marshy meadows, bogs, swamps, small ponds, ditches, or other shallow bodies of water
Emydoidea blandingii	Blanding's Turtle		SE	shallow water along the edges of marshes or ponds
Sistrurus catenatus catenatus	Eastern Massasauga	C	SE	moist prairie habitat or dry sunny locations
Thamnophis butleri	Butler's Garter Snake		SE	Open prairie-like areas
Birds				
Ammodramus henslowii	Henslow's Sparrow		SE	fields and meadows, preferably moist, with combination of grass, forbs, and scattered shrubs
Ardea herodias	Great Blue Heron			freshwater and brackish marshes, swamps, lakes, rivers, mangroves
Aythya collaris	Ring-necked Duck			sedge-meadow marshes, swamps, and bogs with waters ranging from fresh to somewhat acidic
Buteo lineatus	Red-shouldered Hawk		SSC	Riparian forest, wooded swamp
Buteo platypterus	Broad-winged Hawk	no status	SSC	Dense decid and mixed forest, open woodland near water
Certhia americana	Brown Creeper			Northern coniferous forests, and large stands of dying timber, with the large peeling scales of bark
Chlidonias niger	Black Tern		SE	freshwater marshes, sloughs, wet meadows
Cistothorus palustris	Marsh Wren		SE	fresh and brackish water marshes with abundant reeds
Dendroica cerulea	Cerulean Warbler		SSC	Mature decid forest
Ixobrychus exilis	Least Bittern		SE	emergent veg in freshwater, occ coastal brackish marshes, mangroves
Nycticorax nycticorax	Black-crowned Night-heron		SE	marshes, swamps, ponds, lakes, lagoons, mangroves; occ grassland, rice fields
Rallus limicola	Virginia Rail		SE	freshwater, occ brackish, marshes, usu in cattails, reeds, dense grass
Sturnella neglecta	Western Meadowlark		SSC	grassland, savanna, pasture, cultivated fields
Tyto alba	Barn Owl		SE	Open country such as grasslands, deserts, marshes, and agricultural fields.
Wilsonia citrina	Hooded Warbler		SSC	undergrowth in well-watered mature decid forest, esp in ravines
Mammals				
Condylura cristata	Star-nosed Mole		SSC	moist soil in coniferous and deciduous forests, clearings, wet meadows, marshes and peatlands; banks of streams, lakes, and ponds
Lutra canadensis	Northern River Otter		SE	Streams and lake borders
Lynx rufus	Bobcat	no status		Deciduous-coniferous woodlands, hardwood forests, swamps, forested river bottomlands, thick undergrowth; large tracts of land favorable
Mustela nivalis	Least Weasel		SSC	Grassland, successional fields, edges

Table 6 (cont'd). Nobel County Endangered, Threatened, and Rare Species

Species name	Common name	Federal	State	Typical Habitat
Taxidea taxus	American Badger			Grassland, agricultural area
Vascular Plants				
Actaea rubra	Red Baneberry		SR	Cool, moist, nutrient-rich sites
Andromeda glaucophylla	Bog Rosemary		SR	cold bogs
Aralia hispida	Bristly Sarsaparilla		SE	open woods and clearings
Aristida intermedia	Slim-spike Three-awn Grass		SR	arid grasslands
Aster borealis	Rushlike Aster		SR	bogs and swamps
Calla palustris	Wild Calla		SE	bogs, swamps, shallow water
Carex bebbii	Bebb's Sedge		ST	wet meadows, riparian communities, and along beaver ponds, as well as ditches in moderate elevations
Crataegus prona	Illinois Hawthorn		SE	thickets and open woods, woods and river banks in dry clay soils and rich moist soils along the margins of oak woodlands
Cypripedium candidum	Small White Lady's-slipper		WL	calcareous soils of marly bogs, open swamps, wet prairies
Drosera intermedia	Spoon-leaved Sundew		SR	bogs and wet sand
Dryopteris clintoniana	Clinton Woodfern		SX	swamps and wet woods
Eriophorum gracile	Slender Cotton-grass		ST	bogs and swamps
Eriophorum viridicarinatum	Green-keeled Cotton-grass		SR	swamps, bogs, and wet meadows
Gentiana alba	Yellow Gentian		SR	Dry soil and barrens
Geranium bicknellii	Bicknell Northern Crane's-bill		SE	Open woods, fields, lake shores, roadsides, old campfire sites, disturbed soils, and recent burns
Geum rivale	Purple Avens		SE	bogs, wet meadows
Hypericum pyramidatum	Great St. John's Wort		ST	Moist woods, forests, openings, and streambanks.
Lathyrus ochroleucus	Pale Vetchling Peavine		SE	Open woods, thickets, and clearings
Lathyrus venosus	Smooth Veiny Pea		ST	rich woods and thickets
Lemna perpusilla	Minute Duckweed		SX	Mesotrophic to eutrophic, quiet waters in temperate regions with relatively mild winters
Linnaea borealis	Twinflower		SX	boreal forests; in open shade, dry or moist sites, often associated with moss-covered surfaces
Lycopodium hickeyi	Hickey's Clubmoss		SR	hardwood forests and second-growth shrubby areas
Lycopodium obscurum	Tree Clubmoss		SR	moist woods and bog-margins in acid soil
Malaxis unifolia	Green Adder's-mouth		SE	damp woods and bogs
Matteuccia struthiopteris	Ostrich Fern		SR	swamps and moist woods in circumneutral soil
Milium effusum	Tall Millet-grass		SR	rich, moist or dry woods
Panax trifolius	Dwarf Ginseng		WL	rich woods and bottomlands
Panicum leibergii	Leiberg's Witchgrass		ST	dry prairies and open places
Platanthera leucophaea	Prairie White-fringed Orchid	LT	SE	moist prairies and bogs
Platanthera orbiculata	Large Roundleaf Orchid		SX	deeply shaded, rich mesic woods, and shaded to semi-open bogs
Platanthera psycodes	Small Purple-fringe Orchis		SR	wet woods and meadows
Potamogeton strictifolius	Straight-leaf Pondweed		ST	alkaline ponds and streams
Prunus pensylvanica	Fire Cherry		SR	burned areas, woods and clearings
Pyrola rotundifolia var. americana	American Wintergreen		SR	dry or moist woods and bogs
Salix serissima	Autumn Willow		ST	Cold, often calcareous bogs, limy swamps, boggy meadows, and along lakeshores and streambanks at low to mid elevations

Table 6 (cont'd). Nobel County Endangered, Threatened, and Rare Species

Species name	Common name	Federal	State	Typical Habitat
Scheuchzeria palustris ssp. americana	American Scheuchzeria		SE	cold sphagnum-bogs
Spiranthes lucida	Shining Ladies'-tresses		SR	damp woods, marshes, and wet shores, calciphile
Spiranthes romanzoffiana	Hooded Ladies'-tresses		ST	open wet places: bogs, including marly areas, tamarack and cedar thickets and openings, sandy or mucky shores, moist roadsides, ditches, sandy excavations, meadows, beach pools and marshes, interdunal swales, wind swept littoral, tundra, barren chalky sediment around hot springs
Stipa comata	Sewing Needlegrass		SX	dry, sandy, gravelly soils of the Northern Plains
Tofieldia glutinosa	False Asphodel		SR	moist or wet places
Triglochin palustris	Marsh Arrow-grass		SR	brackish marshes along the coast, in bogs inland
Utricularia cornuta	Horned Bladderwort		ST	acid lakes, sandy or muddy shores, peatlands
Utricularia resupinata	Northern Bladderwort		SX	Muddy ground or shallow water at pond edges
Viburnum cassinoides	Northern Wild-raisin		SE	Moist to wet open woods, thickets, and swamps throughout the mixedwood and southern boreal forest
Zigadenus elegans var. glaucus	White Camas		SR	beaches and bogs and other wet, often calcareous places

Indiana Natural Heritage Data Center	Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
Division of Nature Preserves	State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern;
Indiana Department of Natural Resources	SX = state extirpated; SG = state significant; WL = watch list

Table 7. Whitley County Endangered, Threatened, and Rare Species

Species Name	Common Name	State	Federal	Habitat
Vascular Plant:				
ANDROMEDA GALUCOPHYLLA	BOG ROSEMARY	SR		Eastern boreal forests, wet, organic soils, especially in black spruce peatlands and open bogs and fens
BIDENS BECKII	BECK WATER MARIGOLD	ST		Floating leaved to submersed plant community, usually in soft sediments
CAREX ALOPECOIDEA	FOXTAIL SEDGE	SE		Wet woods and swamp forests
CAREX ATLANTICA SSP. ATLANTICA	ATLANTIC SEDGE	ST		Moist acidic substrates - sphagnum bogs, shrub borders, wet woods, thickets
CAREX CHORDORRHIZA	CREEPING SEDGE	SE		Primarily in peat lands - sphagnum bogs, shrub borders, wet woods, thickets
CAREX LIMOSA	MUD SEDGE	SE		Bogs, on sphagnum mats in full sun; rarely in fens
COELOGLOSSUM VIRIDE VAR. VIRESCENS	LONG BRACT GREEN ORCHIS	ST		Moist, rich deciduous woods, frequently on steep slopes
ELEOCHARIS EQUISETOIDES	HORSETAIL SPIKERUSH	SE		Shallow water in emergent marshes, lakeshore edges, and ponds
ERIOCAULON AQUATICUM	PIPEWORT	SE		Margins of clacial lakes, peaty shores; bogs and muskeg
ERIOPHORUM GRACILE	SLENDER COTTONGRASS	ST		Peaty soils and poor drainage; bogs and marshes
PHLOX OVATA	MOUNTAIN PHLOX	SE		Open to semi-open situations in subacid soils: open woods, thickets, occasionally alluvial meadows
PLANTAGO CORDATA	HEARTLEAVED PLANTAIN	SE		Wet woods, sloughs, rocky stream beds, spring branches
POTAMOGETON FRIESII	FRIES' PONDWEED	ST		Submersed aquatic - calcareous to brackish waters: lakes ponds, estuaries

Table 7 (cont'd). Whitley County Endangered, Threatened, and Rare Species

Species Name	Common Name	State	Federal	Habitat
POTAMOGETON PRAELONGUS	WHITESTEM PONDWEED	ST		Submersed aquatic - cold deep waters of lakes
POTAMOGETON PUSILLUS	SLENDER PONDWEED	WL		Submersed aquatic - calcareous to brackish waters: lakes ponds, estuaries
POTAMOGETON RICHARDSONII	REDHEADGRASS	SR		Submersed aquatic - Great Lakes and connecting waterways, inland lakes, rivers and creeks
POTAMOGETON ROBBINSII	FLATLEAF PONDWEED	SR		Submersed aquatic - deep muddy waters of lakes, ponds, and rivers
POTAMOGETON STRICTIFOLIUS	STRAIGHTLEAF PONDWEED	ST		Submersed aquatic - calcareous waters, lakes, ponds, estuaries
SPIRANTHES LUCIDA	SHINING LADIES' TRESSES	SR		Calcareous soils with abundant water supply: moist banks, wet meadows, lakeshores, damp woods, and marshes; often pastures
UTRICULARIA MINOR	LESSER BLADDERWORT	ST		Bogs and fens; floating or rooted in mud - shallow waters
UTRICULARIA RESUPINATA	NORTHERN BLADDERWORT	SX		Muddy ground or shallow water at pond edges
Mollusk: Bivalvia (Mussels)				
LAMPSILIS FASCIOLA	WAVYRAYED LAMPMUSSEL	SSC		Medium sized streams in gravel riffles.
TOXOLASMA LIVIDUS	PURPLE LILLIPUT	SSC		Lakes and small to medium streams in gravel.
Mollusk: Gastropoda				
CAMPELOMA DECISUM	POINTED CAMPELOMA	SSC		Sandy bottoms of rivers
Insect: Lepidoptera (Butterflies & Moths)				
POANES VIATOR VIATOR	BIG BROAD-WINGED SKIPPER	ST		Freshwater and saltwater marshes
Fish:				
COREGONUS ARTEDI	CISCO	SSC		Deep, clear water inland lakes
Amphibians:				
RANA PIPIENS	NORTHERN LEOPARD FROG	SSC		Various aquatic habitats; pastures, meadows, and woodland areas.
Reptiles:				
EMYDOIDEA BLANDINGII	BLANDING'S TURTLE	SE		Mainly aquatic; marshes, bogs, lakes, or small streams.
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA	SE	C	Wet prairies, marshes and low areas along rivers and lakes
Birds:				
AMMODRAMUS HENSLOWII	HENSLOW'S SPARROW	SE		Mesic to wet prairie grasslands
ARDEA HERODIAS	GREAT BLUE HERON			Freshwater marshes, along lakes, rivers, lagoons, fields, and meadows.
LANIUS LUDOVICIANUS	LOGGERHEAD SHRIKE	SE	No Status	Open areas with shrubby hedgerows intermixed with some type of thorny bushes such as hawthorn.
RALLUS LIMICOLA	VIRGINIA RAIL	SE		Freshwater marshes in dense emergent vegetation
STURNELLA NEGLECTA	WESTERN MEADOWLARK	SCC		Grasslands and prairie, also pastures and abandoned fields
Mammals:				
LYNX RUFUS	BOBCAT		No Status	Forested areas, swamps.
TAXIDEA TAXUS	AMERICAN BADGER			Open grasslands and deserts.

Indiana Natural Heritage Data Center	Fed: LE = Endangered; LT = Threatened; C = candidate; PDL = proposed for delisting
Division of Nature Preserves	State: SE = state endangered; ST = state threatened; SR = state rare; SSC = state species of special concern;
Indiana Department of Natural Resources	SX = state extirpated; SG = state significant; WL = watch list

SECTION 3.0 LAND USE

Land use plays a significant role in water quality. Different contaminants are attributed to different types of land use that water encounters as it flows over the land surface. Water flowing across agricultural fields may pick up sediment, fertilizers, herbicides, pesticides, and manure, whereas water flowing off a parking lot may pick up motor oil, axle grease, and transmission fluid. Water flowing across lawns in medium density housing may pick up fertilizers, herbicides, pesticides, and pet waste. Impervious surfaces such as rooftops, roads, or driveways also restrict infiltration of water, causing greater water volumes and sediment and nutrient loads to reach the nearest waterway and cause greater velocities downstream. Water flowing over highly erodible soils causes greater erosion; adding more sediment into waterways. Consequently, an investigation of the ground cover, soil characteristics, and other land uses of the UTRLA Watershed can be helpful in identifying its potential water quality impairments.

3.1 LAND USE DATA

Based on information obtained from the IUPUI-CEES and CUPE 2003 GIS land use layer, land use within the UTRLA Watershed is primarily agricultural, with 7,025 acres (52%) in agricultural production. Corn and soybeans make up the majority of these crops. Grasslands comprise the second largest portion of the watershed, with 2,632 acres (19%), and forests make up 14% (1,901 acres) of the watershed. Open water makes up 8% (1,053 acres) of the watershed, while 274 acres, only 2.4%, of the watershed are residential and 644 acres (5%) are wetlands. The remaining 19 acres (0.1%) of the watershed is composed of bare soil and commercial, industrial or transportation. The IUPUI-CEES and CUPE land use data is summarized in Table 8 and shown on Figures 28 and 29.

Land use is expected to convert from agricultural to residential, commercial, and industrial slowly in general, but residential development may occur rapidly in the areas around the lakes. Noble and Whitley County Zoning Maps show most of the watershed currently zoned to remain in agriculture. The remainder of the watershed is currently zoned as Lake Residential and Recreation, with small areas zoned for Highway Business or Mobile Home. Based on the county zoning, future land use changes in the UTRLA Watershed do not seem to pose an immediate threat to the water quality of the watershed; however, stormwater regulations should be strictly enforced and complied with on all construction and other pertinent sites.

Table 8. 14-digit Watersheds and UTRLA Watershed Land Use

	Loon Lake –Goose Lake/Old Lake Watershed		Tippecanoe River - Crooked Lake/Big Lake Watershed		UTRLA Watershed	
Land Use	Area (Acres)	Percent	Area (Acres)	Percent	Area (Acres)	Percent
High Density Urban	23	0.3%	34	0.5%	57	0.4%
Medium Density Urban	80	1%	137	2%	217	2%
Bare Soil - Sparse Vegetation	0	0%	2	0.03%	2	0.01%
Forest	1128	15%	773	12%	1901	14%
Grasslands/ Suburban Lands	1659	23%	973	15%	2632	19%
Agriculture	3470	48%	3555	57%	7025	52%
Wetland - Forest	350	5%	152	2%	502	4%
Wetland - Other Vegetation	26	0.4%	44	0.7%	70	0.5%
Wetland - Bare	19	0.3%	53	0.8%	72	0.5%
Open Water	499	7%	554	9%	1053	8%
Commercial/Industrial/Transportation	5	0.01%	12	0.2%	17	0.1%
TOTAL	7,259		6,289		13,548	

It was not possible to break down the land use for the subwatersheds using the IUPUI-CEES and CUPE data; therefore the HYMAPS-OWL watershed delineation program was used. The IUPUI-CEES and CUPE data is based on 2003 land use, while the HYMAPS-OWL data is based on 1992 land use. Consequently, the two data sets vary slightly, but still present overall land use trends for the watershed. Land use trends in the subwatersheds are directly reflective of those in the entire UTRLA Watershed, with agriculture as the predominant land use in all of the subwatersheds except for subwatersheds C and J. Subwatershed C, which contains all of Old Lake and a large portion of Loon Lake, is composed of slightly more open water than agriculture. There is more open water, forest, and residential land than agricultural land in Subwatershed J, which contains all of Crooked Lake and two nature preserves. Table 9 shows the land use data from the HYMAPS-OWL program broken down by subwatershed.

Table 9. Subwatershed Land Use

Loon Lake - Goose Lake/Old Lake Watershed

	A		B		C		D		E		F	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Water	50	4	9	4	307	35	54	18	97	5	62	2
Commercial	0	0	0	0	0	0.0	0	0	0	0	0	0
Row Crops	841	65	166	65	150	17	129	43	1315	68	1902	73
Grass/Pasture	15	1	18	7	136	16	28	9	65	3	73	3
HD-Residential	4	0.3	0	0	14	2	0	0	0	0	2	0.1
LD-Residential	60	5	12	5	133	15	25	8	114	6	118	5
Forest	267	21	40	16	101	12	57	19	260	13	403	16
Other	51	4	12	5	28	3	5	2	96	5	40	2
Total	1,289	100	257	100	869	100	297	100	1,947	100	2,600	100

Tippecanoe River - Crooked Lake/Big Lake Watershed

	G		H		I		J		K		L		M	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Water	133	16	152	11	19	2	227	31	1	1	32	4	3	0.3
Commercial	0	0	0	0	2	0.2	0	0	0	0	1	0.1	0	0
Row Crops	508	60	917	67	978	75	59	8	147	69	527	72	995	92
Grass/Pasture	14	2	2	0.1	35	3	29	4	1	1	3	0.4	2	0.2
HD-Residential	17	2	42	3	11	1	10	1	0	0	5	0.7	0	0
LD-Residential	69	8	98	7	84	6	153	21	20	9	50	7	31	3
Forest	84	10	148	11	167	13	253	34	43	20	104	14	46	4
Other	16	2	8	1	10	1	9	1	2	1	13	2	9	1
Total	841	100	1,367	100	1,306	100	740	100	214	100	735	100	1,086	100

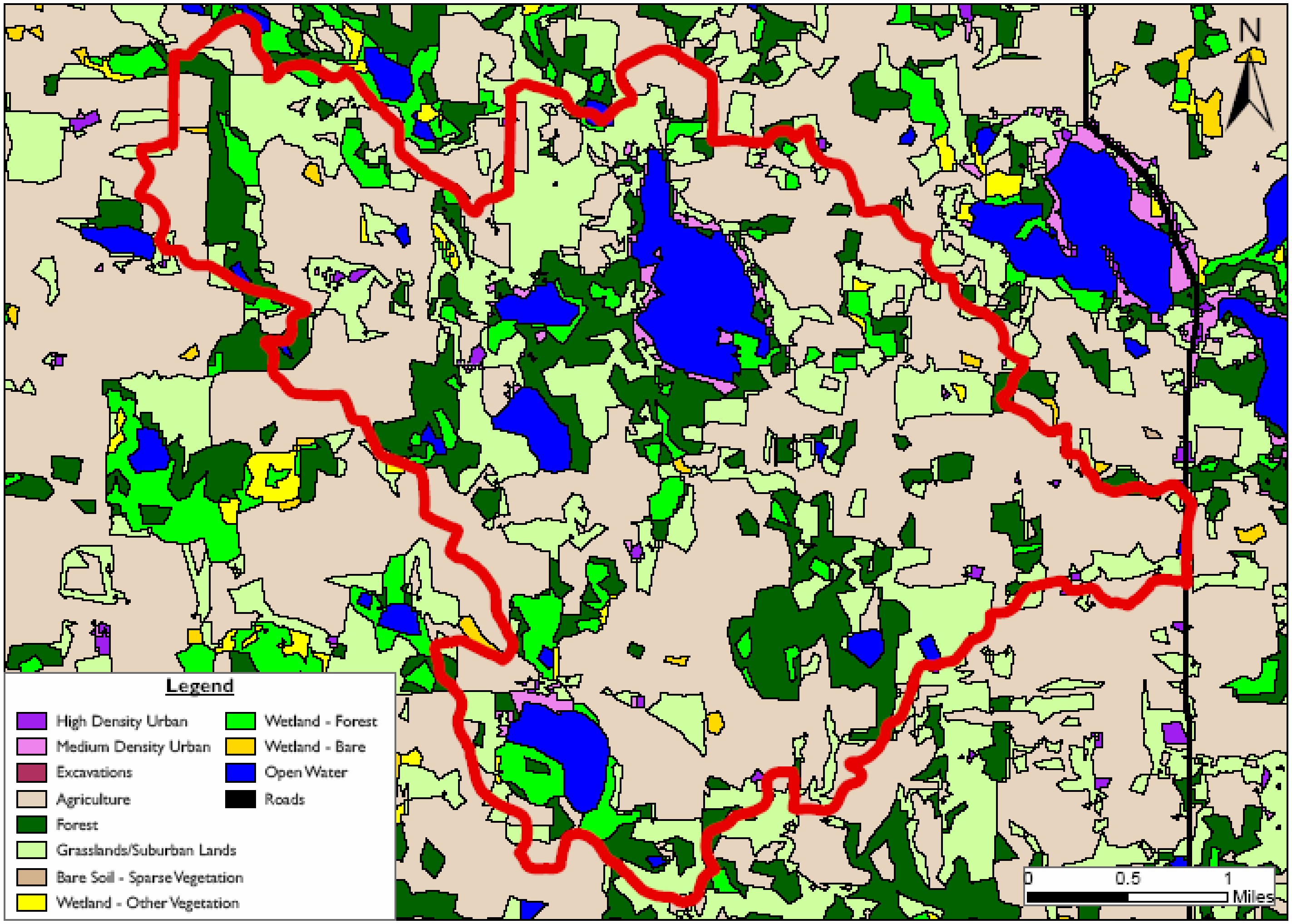


Figure 28. Loon Lake – Goose Lake/Old Lake Watershed Land Use
(Courtesy of CIWRP Pilot Studies, IUPUI-CEES & CUPE, J. Wilson 2003)

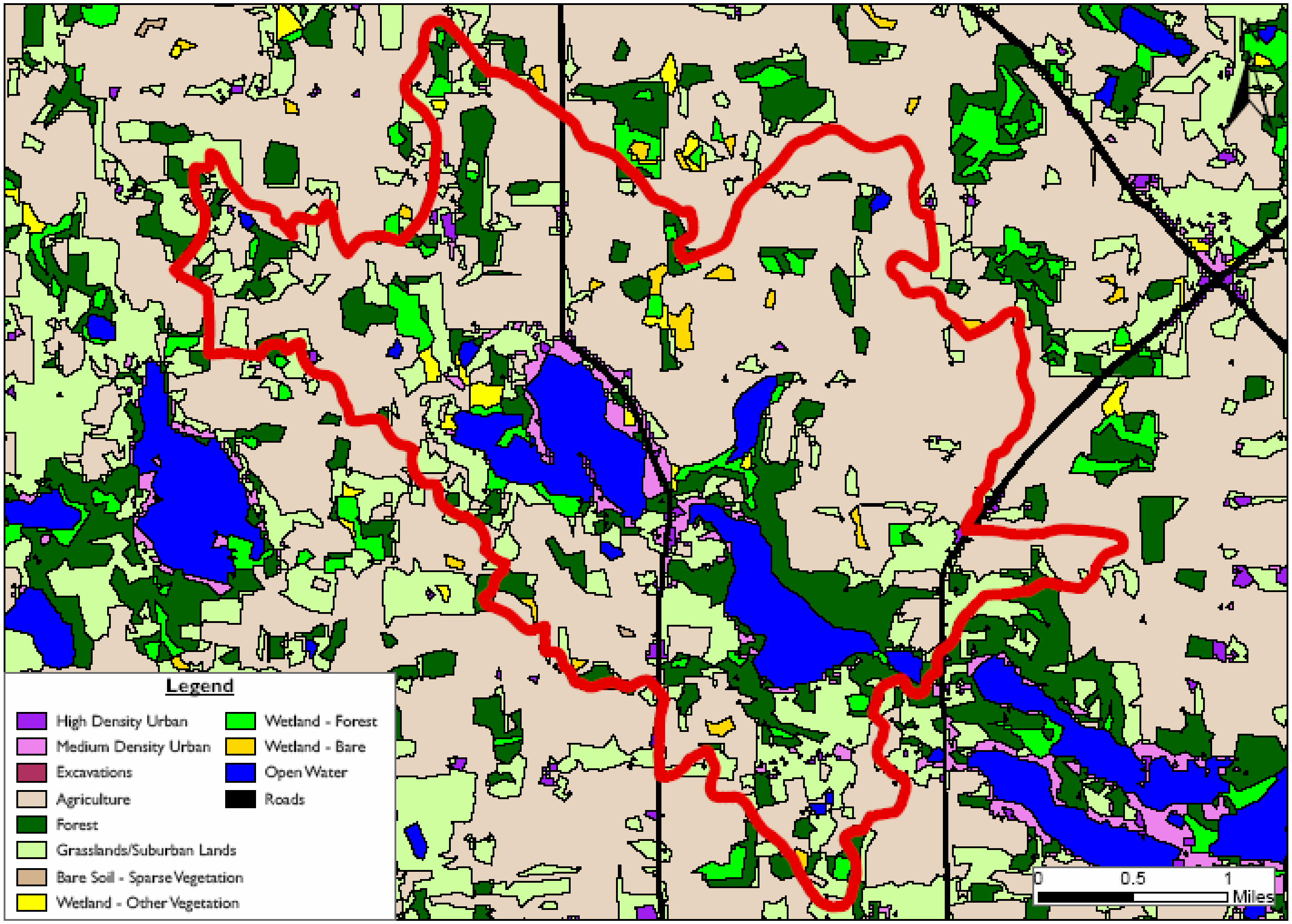


Figure 29. Tippecanoe River – Crooked Lake/Big Lake Watershed Land Use
(Courtesy of CIWRP Pilot Studies, IUPUI-CEES & CUPE, J. Wilson 2003)

3.2 DEMOGRAPHICS

Analysis of population trends can be used to predict future changes in land use. Population growth can be associated with development growth, and can have a dramatic impact on water quality.

The UTRLA Watershed lies within Noble and Whitley Counties, and covers 2.3% of Noble County and 3.5% of Whitley County. Population trends for these two counties are derived from the US Census Bureau, Census 2000 and are shown in Table 10. Using the percentages of the watershed area within each county, an estimation of the population of the watershed was calculated (Table 11). The county information is helpful at estimating the watershed population trends, but may be slightly skewed. Population growth or density is not high for either county and does not currently seem to pose a significant threat to the water quality of the UTRLA Watershed.

Table 10. County Demographics (US Census Bureau, 2006)

County	Area (Acres)	Population (2006)	Pop. Growth (1990-2005)	Pop. Density (persons per square mile)	Unemployment Rate
Noble	262,400	47,918	3.6%	112.6	6.1
Whitley	216,211	32,556	6%	91.4	4.7

Table 11. Estimated Watershed Demographics

County	Area (Acres)	Population (2006)
Noble	5,961	1,089
Whitley	7,587	1,142
TOTAL WATERSHED	13,548	2,231

3.3 IMPERVIOUS SURFACE ANALYSIS

One negative impact on water quality associated with development is the increase of impervious surface, which is defined by EPA as "hard surface area that either prevents or retards the entry of water into the soil mantle or causes water to run off the surface in greater quantities or at an increased rate of flow." The area of impervious surface in the UTRLA Watershed and its subwatersheds was calculated using the typical impervious fraction from the *Watershed Inventory Workbook for Indiana* (Table 12). A study published by Elvidge *et al.*, (2004) showed that watersheds with 11 – 25% impervious cover had streams that exhibited clear signs of degradation. Subwatershed J contains the highest percent of impervious cover (4.74%); however, none of the subwatersheds or the UTRLA Watershed as a whole (2.20%) contain 11% impervious cover. The percentage of impervious cover in the UTRLA Watershed is not expected to change dramatically. Therefore, impervious surface is not a major current threat to the water quality of the UTRLA Watershed.

Table 12. Impervious Surfaces

Subwatersheds	Acres	Percent (%)
A	31	2.5
B	4.9	2.49
C	21.9	2.68
D	6.9	2.79
E	47.7	2.64
F	73.8	2.89
G	32.5	3.76
H	52.9	3.8
I	42.9	3.24
J	36.2	4.74
K	7.6	3.27
L	25.4	3.35
M	25.1	2.27
Total (UTRLA Watershed)	408.8	3%

3.4 SIGNIFICANT RECREATIONAL AND NATURAL AREAS

The land in the UTRLA Watershed is primarily privately owned agricultural land; forested land; or lakes, streams, or wetlands. There are; however, three significant natural areas, a golf course, and six public lake access sites located within the watershed (Figure 30). There are DNR owned public accesses at Big, Crane, Crooked, Loon, and Old Lakes, and the Goose Lake Resort and Boat Ramp provides public access to Goose Lake.

The Crooked Lake Nature Preserve, located in subwatershed J, is owned and managed by the IDNR. The preserve consists of 145 acres of forested land with wetlands and a large pond, 0.5 miles of undeveloped shoreline, and an island in Crooked Lake. A one acre tract of the preserve is owned by ACRES, Inc. and serves as a memorial to former Governor of Indiana, Ralph F. Gates. Also located in subwatershed J is a 9-hole golf course, Crooked Lake Golf Course. Several intermittent streams and ditches drain the golf course, but all flowed relatively free of sediment after a significant rain event (Crisman, 1993). Crisman's study also determined that fertilizer was only applied to the golf course twice a year (spring and fall) and herbicide application rates were relatively low, which would most likely not cause elevated nutrient or chemical loads on a yearly basis to the tributaries and Crooked Lake.

The Indiana/Purdue at Fort Wayne (IPFW) Crooked Lake Biological Station is also located in subwatershed J. This biological station was constructed in the 1960s and is primarily used for college classes in limnology and aquatic ecology by multiple universities. The facility consists of a field station, a boathouse, and a pontoon and several row boats for physical, biological, and chemical sampling on Crooked Lake, all on a large, forested plot.

The Goose Lake Fish and Wildlife Area, located in subwatershed E, is a 40 acre parcel that was deeded to the Indiana Department of Natural Resources in 1999. The scenic area is used as wetland conservation and the site of the public access for Goose Lake. Also located in subwatershed E is a small portion of Camp Whitley, a youth camp.

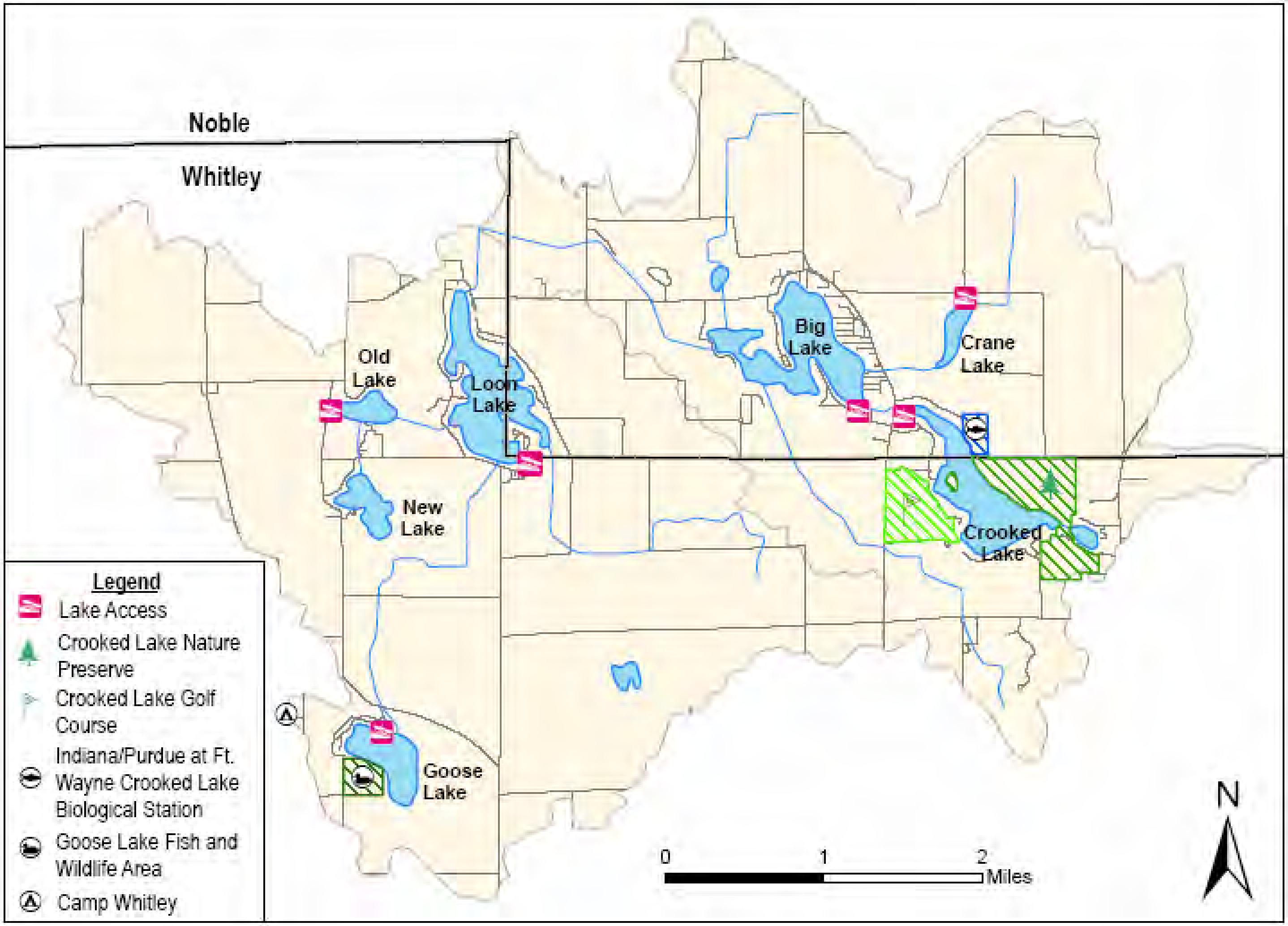


Figure 30. Recreational and Natural Areas in the UTRLA Watershed

3.5 AGRICULTURE

Agriculture is the predominate land use in the UTRLA Watershed; therefore a more thorough investigation into this land use was conducted.

3.5.1 Tillage Practices

Tillage transects are surveys conducted by the Indiana Conservation Partnership to assess tillage trends within each county. Tillage trends are a valuable tool in determining projected sediment erosion rates. The transects look at approximately 450 predetermined sites throughout the county to measure the amount of crop residue after crop planting.

Tillage Data

Noble and Whitley Counties conducted tillage surveys in the spring of 2004. Both counties have high mulch till rates for corn, and all have high no-till rates for soybeans. Included is a summary of trends associated with the adoption of no-till crop production, crop residue cover and soil loss (Lake et. al. 2000). This data was obtained as a result of spring surveys of Indiana cropland. In an "average sized" Indiana county, a sample size of 450 crop fields produces a 95 percent level of confidence (Hill 1995).

Figures 31 and 32 show till trends in each of the two UTRLA Watershed counties for 2004 (*Indiana State Department of Agriculture Division of Soil Conservation*). The windshield survey conducted as part of preparing this watershed management plan concurs in general with the 2004 tillage transect data. Example photos of different tillage practices are shown on Figures 33 through 35.

Although the tillage transects reflect comparisons for the entire county, windshield tours of the ULTRA Watershed completed for the purpose of this study revealed that most tillage completed in the two counties is completed in the spring. This means the soil remains covered with residue during the fall, winter, and early spring providing more soil protection and less erosion.

No-till Trends

No-till revolutionized the industry of agricultural production during the 1990s. Less than 10 percent of all cropland was managed in a no-till system in 1990. Initially, corn was considered the better adapted crop for no-till. In 1990, the percentage of crops managed in a no-till system were nine and eight percent for corn and soybean, respectively. By 1992, the curves for corn and soybean no-till adoption were diverging. Soybeans were better adapted to the no-till environment than the corn hybrids of that time. Management skills for no-till corn were realized to be more demanding than for no-till soybean. The no-till drill facilitated a no-till soybean production boom. By 1995, Indiana became the first corn-belt state to produce more than half of its soybean acres on no-till managed fields.

While no-till is beneficial for soil conservation, it can result in an increased use of agricultural chemicals. Herbicides are used to treat weeds in a no-till system that would be mechanically controlled in a conventional tillage system. Based on a Purdue University publication, no-till, however, reduces pesticide run-off by an average of 70 percent, water run-off by 69 percent, and soil erosion by 93 percent (Conservation Technology Information Center). Therefore, although no-till may require more herbicide use, it holds most of these and other chemicals in place with the soil so they cannot be transported to streams and ditches. Pairing buffer strips with no-till would increase the chemical, nutrient, and sediment removal efficiency rates.

Mulch Tillage

Mulch tillage is defined as any tillage system leaving 30 percent or more crop residue cover on the soil surface after planting. No-till is without question the most effective conservation practice for reducing soil erosion and improving water quality. The crop residue cover and infiltration rates associated with no-till maximize the volume reduction of agricultural runoff and contaminants, when compared to other conservation tillage systems. The 30 percent soil cover that is achieved by conservation tillage is significant to reducing soil erosion by 50 percent or more compared to bare soil. Soil erosion and runoff are considered by volume the greatest contaminant of surface water in most Indiana watersheds. Not only does conservation tillage reduce soil erosion, but it also maintains the long-term productivity of the soil, and reduces production costs for farmers.

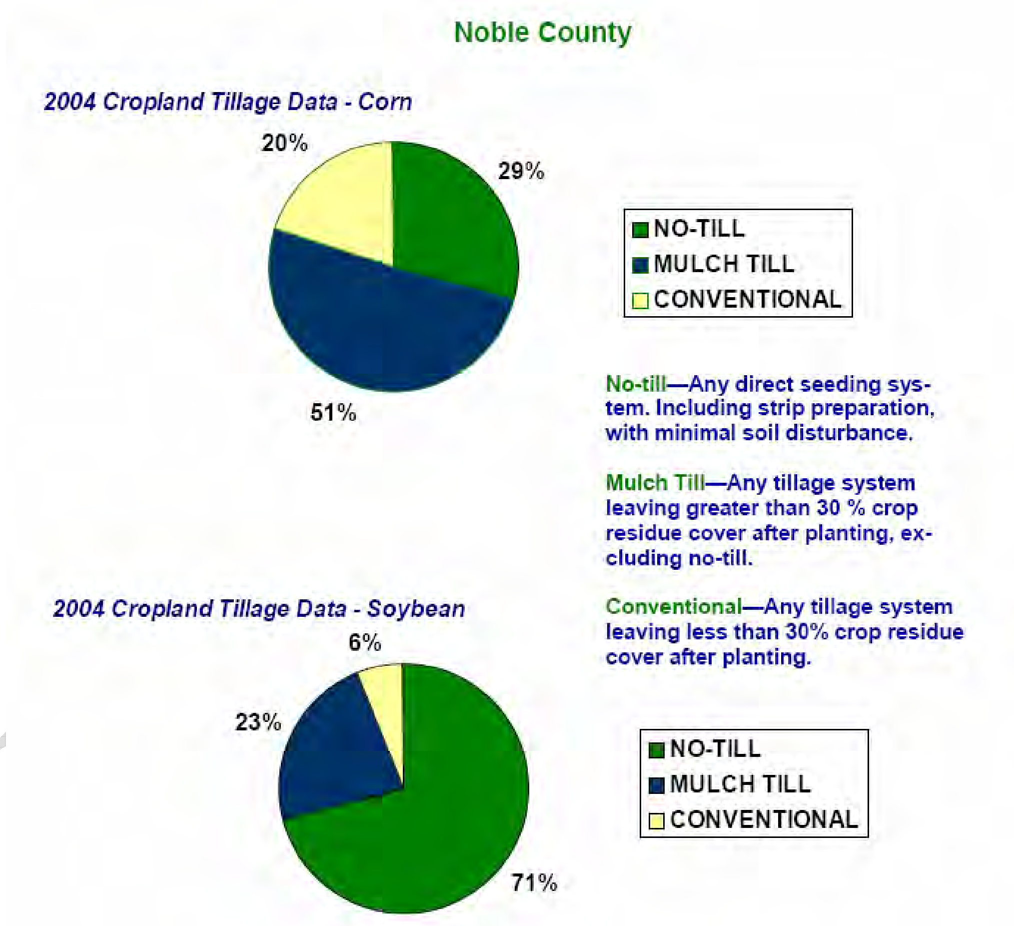


Figure 31. Noble County 2004 Tillage Data

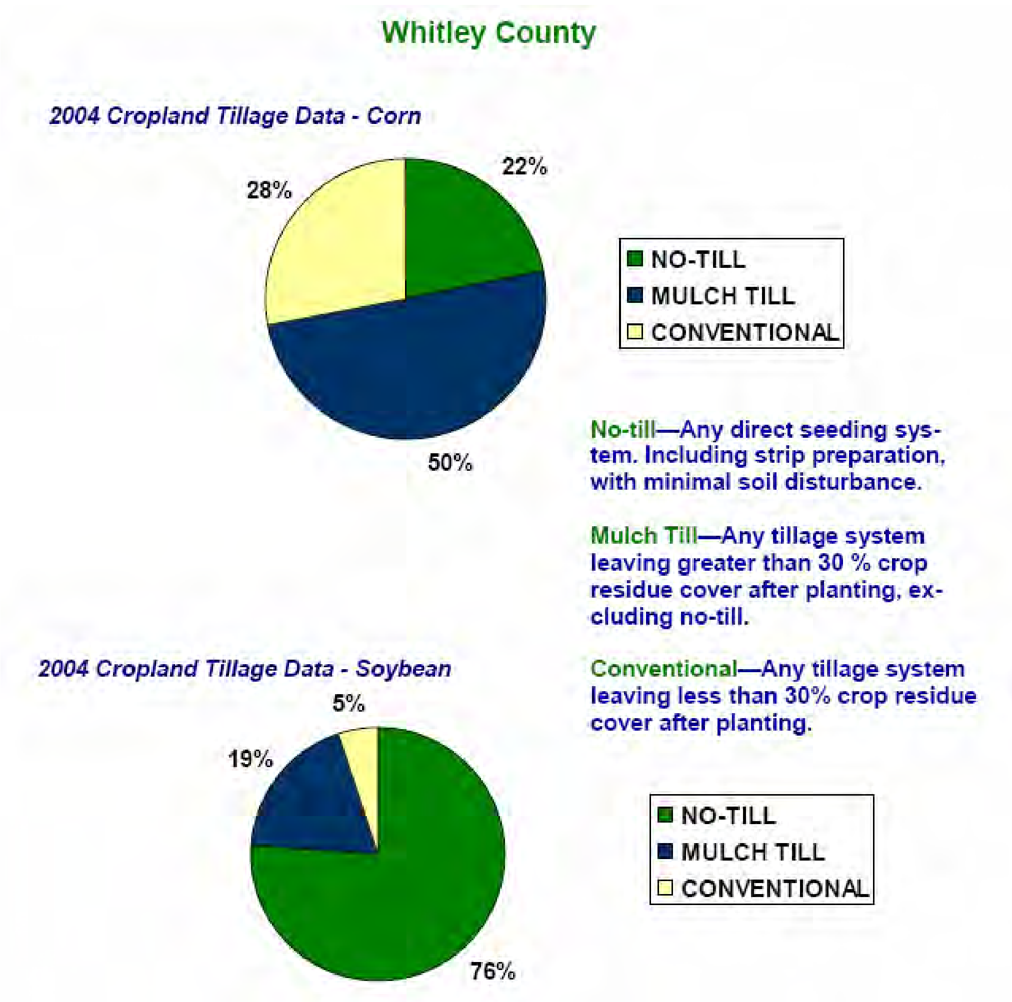


Figure 32. Whitley County 2004 Tillage Data

Figure 33. Conventional Tillage

Figure 34. Mulch Tillage

Figure 35. No-Till

3.5.2 Agricultural Chemicals

Agricultural fertilizers, herbicides, and pesticides are commonly applied to row crops in Indiana. The nutrients in these chemicals can be carried to streams through surface runoff and tile drains, especially if a rain event occurs before the chemicals have a chance to break down and be used by the crops.

As information on agricultural chemical use is not available for the UTRLA Watershed, values were estimated based on Indiana usage. The National Agricultural Statistics Service (NASS), USDA collected the following information on agricultural chemical usage in Indiana in 2006; type, area applied, number of applications per year, and application rates. Corn and soybeans are the primary crops in Noble and Whitley Counties, and between these two counties, approximately 47% of the cropland is planted to corn, while 53% is planted to soybeans (Table 13). Applying these percentages to the UTRLA Watershed cropland, and using the statewide agricultural chemical data from the Office of Indiana State Chemist (2005), agricultural chemical usage for the UTRLA Watershed was estimated (Tables 14 and 15).

Most of the fertilizers in the UTRLA Watershed are applied to corn. Based on the estimations described above, corn receives 98% of the nitrogen and 91% of the phosphorus applied to the UTRLA Watershed. The soil composition, tillage practices, crop types, crop rotations, and weather determine the fertilizer type and application method. Typically, two applications of nitrogen based fertilizers are applied each year to corn in Indiana, one at or just before planting, and another, larger application when corn is approximately one foot tall (Indiana Agricultural Statistics Service, 1992).

Herbicides and pesticides are also applied to crops, with herbicide application being the more prevalent of the two in Indiana. Atrazine is the top active ingredient in corn herbicides, while Glyphosate is the top active ingredient in soybean herbicides. An increase of herbicide use in Indiana is resultant of the increase of no-till farming practices in Indiana. Chemical testing was not conducted during this study to detect Atrazine or Glyphosate levels in the UTRLA Watershed.

Table 13. Acres of Corn and Soybeans in Noble and Whitley Counties
(NASS USDA 2006)

Counties	Corn (Acres)	Soybeans (Acres)
Whitley	50,529	70,839
Noble	60,170	56,026

Table 14. Agricultural Chemical Usage for Corn in the UTRLA Watershed

	Corn Acres	Area Applied (%)	Acres applied	Rate per crop year (lbs./acre)	Total Mass Applied (lbs/year)
Nitrogen	3191	100	3191	147	469,077
Phosphorus	3,191	93	2,967	77	343,238

Table 15. Agricultural Chemical Usage for Soybeans in the UTRLA Watershed

	Soybean Acres	Area Applied (%)	Acres applied	Rate per crop year (lbs./acre)	Total Mass Applied (lbs/year)
Nitrogen	3680	16	589	17	10,013
Phosphorus	3680	20	735	47	34,545

3.5.3 Tile Drains

Tile drains have been determined to affect water quality in many parts of Indiana. Newer tile drains usually consist of perforated, flexible tubes, while older tile drains are commonly clay tile. Information on the number and location of tile drain systems in Indiana is not available; however, agricultural experts expect that nearly all poorly drained farmland contains tile drain systems (Schnoebelen et al., in press). Based on the majority of poorly drained soils and the heavy emphasis on agriculture in the UTRLA Watershed, it can be assumed that most of the agricultural land in the watershed, and therefore a large portion of the watershed is artificially drained. Tile drains short circuit infiltration into the soil and bypass riparian buffers, therefore transporting nutrient laden water directly to nearby ditches or streams. Tile drains can be particularly problematic to water quality if rainfall occurs shortly after the application of fertilizers or manure. Studies are being conducted that may link the hypoxic zone or "dead zone" in the Gulf of Mexico to high nitrogen loads from agricultural drainage in the Midwest to the Mississippi River. Numerous studies, including a Purdue University study, *Interpreting Nitrate Concentration in Tile Drainage Water*, have found high nitrogen concentrations in tile drains, and determined that agricultural fertilizers, manure application, conventional tillage, crop rotation, and the spacing of the tile drains all influence the amount of nitrogen entering tile drains (Bongen *et. al.*). Figure 36 displays a tile drain outletting into a drain in the UTRLA Watershed.

Figure 36. Tile Drain in the UTRLA Watershed

SECTION 4.0 STAKEHOLDER INPUT

4.1 STEERING COMMITTEE

The UTRLA Steering Committee is made up of representation from Big, Crooked, Goose, Loon, Old and New lakes. The UTRLA Steering Committee members are listed in Table 16.

Table 16. UTRLA Steering Committee Members

NAME	LAKE
Jeff Kapp	Big
Mike Martin	Big
Donna Jones	Loon
Don Davis	Loon
Marc Lipman	Loon
Jeanne Rethlake	Old
Jan Barkley	Crooked
Dan Platter	New
June Whittamore	Big
Larry Walter	Goose
Ruth Orr	Big
David Heckman	Goose
Charles Loomis	Old
Jane Loomis	Old
Matt Buchanan	Loon
Mike and Cindy Fitch	Crooked
Jim Brock	Loon
Ken Ebbinghouse	Loon

Holly LaSalle of the Tippecanoe Environmental Lake and Watershed Foundation (TELWF) and Gene Haskins of the Whitley County Soil and Water Conservation District (SWCD) also participated regularly in Steering Committee meetings. Other local leaders/professionals were invited into the strategic planning process as topics warranted, including Scott Zigler, Noble County Surveyor and Jed Pearson, IDNR Fisheries Biologist.

Meetings occurred on a regular basis on the second Tuesday of each month. Summer meetings (July and August) were replaced with larger public educational meetings and workshops. Staff from Empower Results facilitated and led most steering committee meetings; however, Williams Creek staff provided diagnostic study updates as a regular part of each agenda. The Steering Committee successfully worked through a strategic planning process to identify concerns, set goals, determine strategies, and plan for future implementation. The identification of local lake and watershed concerns was complemented with input from the public based on interactive verbal exchanges and/or written surveys at each public meeting or event. Results of the strategic planning effort are outlined in the below tables and future organizational structure. During the steering committee meetings, a total list of watershed partners/stakeholders were discussed for potential future alliances and is included as Appendix A.

4.2 PUBLIC INVOLVEMENT

The project included four (4) public involvement and/or educational events. The initial public meeting was held on December 12th, 2006 at the Big Lake Church of God on SR 109 north of Columbia City. Approximately 70 people attended with diverse representation from most of the lakes in the watersheds. This first meeting introduced attendees to watershed planning principals and included an interactive issue identification session. Participants were then allowed to help prioritize the issues of concern via a flip chart/colored dot exercise. Interest surveys were distributed and collected in an effort to determine what environmental topics the general public was interested in learning more about. The findings from these surveys were used to determine educational programming as part of this project, as well as other future programs. Results are shown in Figures 37 and 38.

The public concerns/issues identified at the public meeting and with the steering committee are listed below:

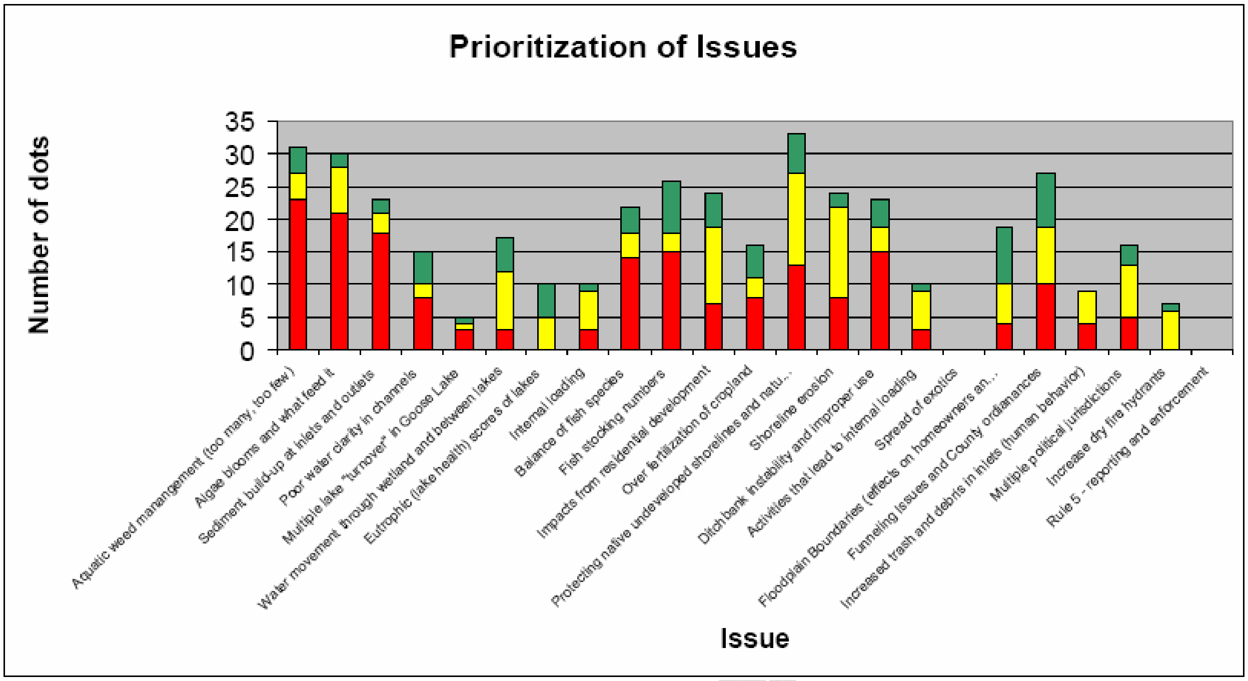
<u>Water Quality Concerns</u>
Aquatic weed management (too many, too few)
Algae blooms and what feed it
Sediment build-up at inlets and outlets
Poor water clarity in channels
Multiple lake "turnover" in Goose Lake
Water movement through wetlands and between lakes
Eutrophic (lake health) scores of lakes
Internal loading

<u>"Other" Natural Resource Concerns</u>
Balance of fish species
Fish stocking numbers
Impacts from residential development
Over fertilization of cropland
Protecting native undeveloped shorelines and natural areas
Shoreline erosion
Ditchbank instability and improper use

<u>Public Involvement Needs or Concerns</u>
Human activities that lead to internal loading
Spread of exotic species

<u>Local Coordination Needs or Concerns</u>
Floodplain Boundaries (effects on homeowners and resale)
Funneling Issues and County ordinances
Increased trash and debris in inlets (human behavior)
Multiple political jurisdictions

<u>Resource Needs or Concerns (data, financial, people)</u>
Increase dry fire hydrants
Rule 5 - reporting and enforcement



Red = a Major Concern or Need
Yellow = an Important Need or Concern, but Less Critical
Green = a Relatively Minor Need or Concern

Figure 37. Prioritized Public Concerns/Issues

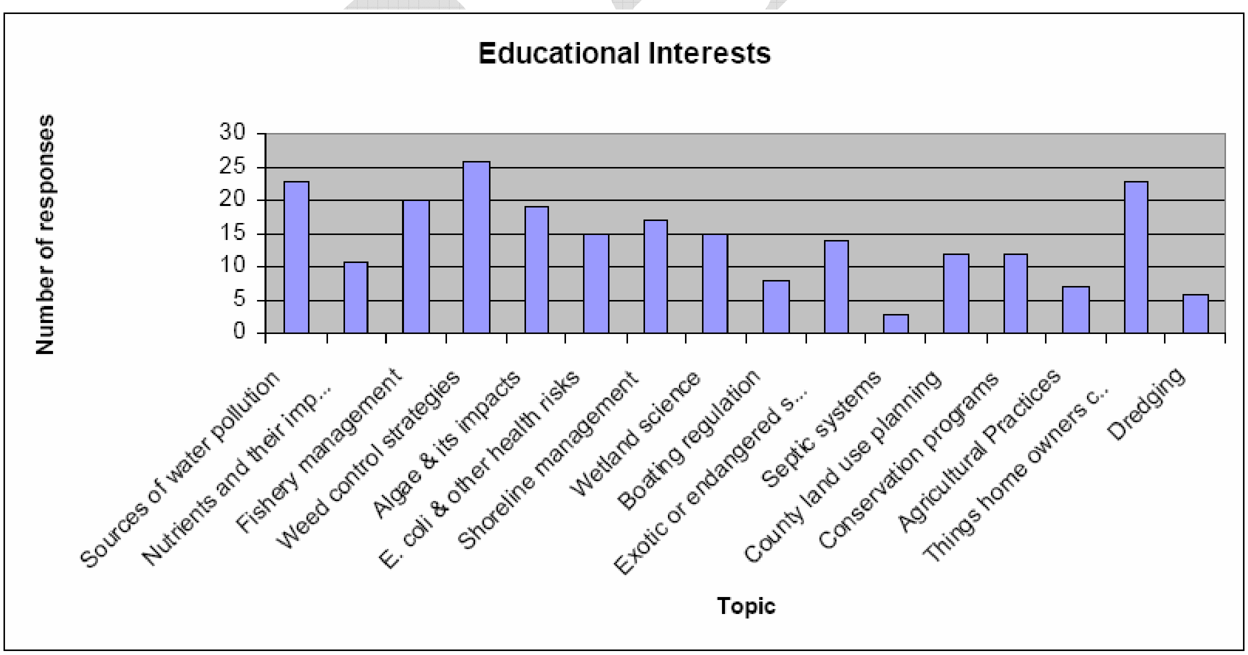


Figure 38. Public Education Interests

The second public meeting was held at the Big Lake Church of God on July 12th, 2007. Approximately 100 people were present. The meeting was structured with a less traditional format. It included two short technical presentations on aquatic plant and fish management, as well as an open question and answer session directed to a panel of experts. The panel included IDNR fisheries biologists and limnologists, and private herbicide applicators. The Steering Committee drafted sample questions in advance of the meeting in order to initiate the start of the discussion. Questions ranged from aquatic plant regulation to exotic species such as zebra mussels to water chemistry.

The third public meeting was conducted, in part, as a hands-on workshop. The meeting/workshop was held at the Big Lake Church of God on August 9th, 2007, and approximately 40 people attended. The primary topic of this meeting was Water Quality Basics. The water quality "diagnostic" theme was explored by explaining the interaction of various chemical parameters, habitat, and biotic indices. Participants were allowed to handle various water quality instruments and view live macroinvertebrates under view-finders. Commonwealth Biomonitoring shared some preliminary results from the current sampling efforts on lake inlets and outlets. The public was encouraged to ask questions throughout the workshop.

The final public outreach event was a more traditional style information meeting, also held at the Big Lake Church of God. The December 13th meeting drew approximately 40 attendees and focused on reporting the findings of the study. Those in attendance were also directed to what they as home owners could do to make immediate improvements in water quality and steward the watershed. The public mailings announcing all of the public meetings are included as Appendix B.

4.3 STRATEGIC PLAN

The UTRLA Steering Committee is a recently formed, informal organization; however, this project has allowed the Committee to move through a strategic planning process that has assisted in formulating a more formal work plan and organizational structure.

The future work of the Steering Committee will be tied together by the group's new mission statement.

> UTRLA's Mission – *The Upper Tippecanoe River Lakes Association (UTRLA) exists to coordinate resources and share information between local lake associations and with other watershed stakeholders. UTRLA's Steering Committee is a representative group of watershed landowners focused on developing and implementing strategies to help protect and improve water quality in the Upper Tippecanoe River Watershed and its lakes.*

Goals

The public concerns listed in section 4.2 were evaluated by the Steering Committee and associated goals were developed to help address the concerns that were decided to be of high priority. The eight goals that were developed include:

- Goal 1: Create a weed management program that balances needs of multiple lake users.
- Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.
- Goal 3: Develop sustainable fish populations that support the recreational needs of lake users.
- Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.

Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use.
Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion and other threats.
Goal 7: Provide information and technical education through a wide variety of communication strategies.
Goal 8: Involve government officials in environmental issues and initiatives in the watershed.

Strategies

Through a facilitated process, the Committee identified strategies to achieve the above goals. Committee members then prioritized the various strategies and worked to determine a responsible party for each strategy. This exercise helped the group to decide the necessary future structure of the organization and outline work that may be better suited to smaller committees and/or consultant(s) and/or individuals. Table 17 and subsequent work plans/topics for each responsible party (described below) set forth a series of activities and actions the Steering Committee believes will address many of their concerns regarding lake management and position them to be more proactive about lake protection. The "Xs" in the table represent the majority opinion regarding priority level and appropriate responsible party(s).

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4.3.1 Work Plans by Responsible Parties

Some of the strategies have significant crossover and may require outside research and product development. These tasks may therefore be better suited for smaller groups (Sub Committees). Likewise, some activities require expert technical assistance from environmental consultants or may only require one person in order to maintain consistency and accountability. Strategies from the above table were assigned to one of the below responsible parties. The relative priority of each suggested activity is also summarized below. Finally, upon looking at the Sub Committee tasks, the Steering Committee gave consideration and discussion toward sorting these tasks by topic so topical leadership could develop among the Steering Committee members.

Steering Committee

Now:

- Engage and utilize SWCD supervisors and staff
- Build relationships with county officials
- Get schedule of each lake's annual meeting and other organizations' meetings and plan talks at each

Soon:

- ID groups that have alternative views and bring them into the planning process
- Develop a stable funding source for projects
- Contact Conservation Officers for better enforcement of recreational violations (boating, piers, etc.)
- Provide articles for watershed newsletters and websites (project or organizational updates)
- Utilize boat ramps (host events at ramp, plan for surveys)
- Form sub committees and ID the individual responsible for contacting law makers and media

Later:

- Coordinate aquatic plant treatment between adjoining lakes
- Share lessons learned on lake by lake basis
- Host technical workshops (with food and beverage)
- Plan for demonstration site field days and/or attend others' events (SWCDs, etc.)
- Help develop a new erosion control ordinance for all land disturbing activities
- Encourage enforcement of shoreline and wetland restrictions (use local venues)
- Better understand funding for ditch maintenance and maintenance process
- Increase funding for ditch maintenance and protection projects
- Host topical workshops
- Develop fundraising events for education programs
- Host Congressional field day

Sub Committees

<u>Education Committee</u>

Now:

- TBD

Soon:

- Acquire and disseminate info on successful weed control strategies
- Share fishery info in public-friendly way
- Educate area Plan Commissions and Zoning Boards

- Provide articles for watershed newsletters and websites (specific educational topics)
- Develop informational pamphlets

Later:

- Educate landowners and visitors on values and problems of various weeds
- Host technical workshops (with food and beverage)
- Conduct demonstration site field days (in cooperation w/ SWCDs or regional MS4 events, etc.)
- Learn about fish stocking programs
- Explore the use of artificial fish habitat or other habitat improvement projects
- Create a brochure on agricultural statistics and practices aimed at lake residents/lay people
- Contact realtors and developers about ecological impacts and property values
- Host topical workshops
- Develop ways to reach kids in schools or 4-H

Public Relation Committee

Now:

- Coordinate distribution of newsletters, brochures, websites (who has what)
- Raise awareness of County officials (particularly Noble Co.) to needs of the lakes (using Kosciusko and Whitley ordinances as examples)
- Develop list of contact info for key local environmental staff, media, business, and other county/regional environmental groups

Soon:

- Conduct surveys to determine interest and needs for certain topics
- Utilize boat ramps (use kiosks, promote events, and/or provide survey boxes)
- Craft standard messages for all members to deliver

Later:

- Share lessons learned on lake by lake basis
- Advertise others' events (SWCDs, etc.)
- ID who fishes the lakes and what they are catching (spend time on ramps, resident surveys, creel survey info from DNR)
- ID differences in fishery expectation of residents and non-residents

Regulatory/Government Relations Committee

Now:

- Develop list of contact info for key regulatory players and government officials

Soon:

- Create exchange of info with DNR regarding options for seawalls, erosion control, etc. (then pass to other committees)
- Determine what the current legal restrictions are for shorelines and wetlands and who regulates various resources

Later:

- Help develop a new erosion control ordinance for all land disturbing activities
- Host Congressional field day

Consultant(s)

Now:
- Review historic data
- ID what plants we have where and who's treating them
- ID areas of aquatic plants concerns
- ID all ditches, inlets, outlets, and natural area on master map

Soon:
- Create reusable PowerPoint presentations
- ID and understand current and past condition of fish populations
- Determine where the legal shorelines are located
- Assist in determining what the current legal restrictions are for shorelines and wetlands and who regulates various resources
- Determine locations of shoreline erosion and recommend methods to prevent erosion
- Develop informational pamphlets with committees (provide technical info)
- Design and implement nutrient reduction projects (BMPs, construction projects, etc.)

Later:
- Conduct technical workshops
- Assist with demonstration site field days
- Advise on the use of artificial fish habitat or other habitat improvement projects
- Provide experts to come talk to general public and lake residents on specific topics
- Assist with a brochure on agricultural statistics and practices aimed at lake residents/lay people
- Conduct a workshop with hands-on water quality modules
- Help develop a new erosion control ordinance for all land disturbing activities

Individual

Now:
- Invite media to meetings
- Invite county officials to UTRLA meetings
- Email officials regular updates

Soon:
- Invite legislators to events
- Send UTRLA products to officials
- Participate in county comprehensive planning process

Later:
- Set one-on-one meetings with law makers in the off-season

4.3.2 Future Organizational Structure of the UTRLA

Leadership

The Steering Committee will initially be led by a Chairperson. It is anticipated that future Officer positions will be established. The Chairperson will rotate annually, or until another more formal election process is implemented. The Chairperson is responsible for coordinating meetings, agendas, and documenting major happenings.

Representation

Each lake in the watershed will identify one (1) official representative that will have voting rights on the Steering Committee. Other representatives from the lakes are welcomed and encouraged to participate in UTRLA meetings. The official representative from each lake can send a proxy voting representative if they cannot attend a meeting; however, advanced notice should be given to the Chairperson if possible. UTRLA Steering Committee representatives from the lakes are expected to regularly report UTRLA activities to local lake association Presidents.

Current UTRLA Steering Committee members would like to extend participation invitations to the following non-lake stakeholders:

- Whitley and Noble County Soil and Water Conservation Districts (SWCDs)
- Whitley and Noble County Surveyors
- Indiana Department of Natural Resources
- Ducks Unlimited
- Pheasants Forever
- B.A.S.S.

These groups would also identify one voting member to participate on the Steering Committee.

Meeting Schedule

The UTRLA Steering Committee will have standing monthly meetings the second Tuesday of each month at 6:30 p.m.

Critical Paths / Immediate Tasks:

1.) Define/Develop Organizational Structure & Establish 1 year business plan.
    a. Set future agenda items based on work plans
    b. Identify what items/tasks should stay with individual lake associations

2.) Share resources regularly to raise awareness.
    a. Consistent, key messages (existing newsletter articles, etc.)
    b. Promote UTRLA as an organization

3.) Fundraising
    a. Discussion about a potential UTRLA dues structure
    b. Plan other "pass the hat" events – events should be tied to educational program needs

SECTION 5.0 BASELINE CONDITIONS

To help define and prioritize potential watershed issues, the planning team evaluated existing data, conducted biological and chemical sampling and habitat evaluations, conducted an intensive Watershed Survey, applied a theoretical pollutant load model, and calculated the water budget for each lake. Specifically, these efforts included:

1. IDEM 2006 303(d) List of Impaired Water bodies.
2. Design Report, Inspection Plan, Operation and Maintenance Plan, and Post-Construction Monitoring Plan – Crooked Lake (October 1995).
3. Design Report, Inspection Plan, Operation and Maintenance Plan, and Post-Construction Monitoring Plan – Loon Lake (December 1997).
4. A Preliminary Assessment of Big Lake, Noble County (1992-1995).
5. Assessment of Watershed – Lake Interactions Influencing the Cultural Eutrophication of Little Crooked and Crooked Lakes, Indiana (April 1993).
6. Crooked Lake, Noble – Whitley Counties, Cisco Population Status (2005).
7. Feasibility Studies of Loon Lake and Goose Lake (March 1992).
8. Upper Tippecanoe River Watershed Management Plan, Kosciusko, Noble, and Whitley Counties, Indiana (July 2006).
9. IDNR Fisheries Studies.
10. Water Quality Sampling – tributary chemical sampling, macroinvertebrate sampling, habitat evaluations, and an in-lake water chemistry assessment.
11. Aquatic Plant Identification.
12. Watershed Survey.
13. The Spreadsheet Tool for Estimating Pollutant Loads (STEPL) modeling.
14. Hydrologic Budgets.

5.1 PAST STUDIES IN THE UTRLA WATERSHED

Past studies in the UTRLA Watershed were reviewed to obtain a better understanding of the past conditions of the watershed and its water quality.

5.1.1 IDEM 2006 303(d) List of Impaired Water Bodies

2006 Indiana Integrated Water Quality Report

Section 305(b) of the federal Water Pollution Control Act (the Clean Water Act, amended in 1987) requires states to prepare and submit to the U.S. Environmental Protection Agency (U.S. EPA) a water quality assessment report of state water resources every two years. The Indiana Department of Environmental Management (IDEM), Office of Water Quality (OWQ) has prepared the 2006 Indiana Integrated Water Quality Report following the guidelines provided by U.S. EPA.

Results from this assessment determined support of designated uses for each stream according to U.S. EPA assessment guidelines (U.S. EPA 1997b). Sampling results allowed IDEM to assess the suitability of the lakes and streams in the UTRLA Watershed for aquatic life use and primary contact use (Table 18). The portion of the Tippecanoe River within the watershed failed to meet its designated aquatic life use and primary contact use criteria. Crooked Lake failed to meet its fish consumption criteria, and is only partially supportive of aquatic life.

303(d) List of Impaired Waters

Section 303(d) of the Clean Water Act requires states to identify waters that do not or are not expected to meet applicable water quality standards with federal technology-based standards alone. States are also required to develop a priority ranking for these waters taking into account the severity of the pollution and the designated uses of the waters. The EPA approved Indiana's initial 303(d) list, and IDEM publishes and updates this list once every two years. Table 19 lists relevant water bodies within the UTRLA Watershed placed on the 2006 303(d) list. Impaired water bodies are shown on Figure 39.

Table 18. IDEM 305(b) Site Specific Water Body Assessment

WATERBODY SEGMENT NAME	WATERBODY SEGMENT ID	14-DIGIT HUC	SIZE	AQUATIC LIFE USE	PRIMARY CONTACT USE	FISH CONSUMPTION	DRINKING WATER USE	MOST RECENT ASSESSMENT DATE (yyyymmdd)
Tippecanoe River	INB0611_00	5120106010010	1.86 miles	N	N	X		20050331
Crooked Lake	INB06P1001_00	5120106010010	206 acres	P	X	N		20060329
F = fully supporting; N = not supporting; P = partially supporting; X = not assessed								

NOTES:

Aquatic Life Use

IDEM Office of Water Quality believes that the most consistent way to evaluate overall use support is best represented by the stream miles supporting aquatic life use, which is a designated use in the Indiana Administrative Code. For these comprehensive assessments, a stratified random sampling design was used to computer generate sampling sites, which provided a representative sample set for each basin in the state. Fish community index of biotic integrity (IBI) was determined for each sampling location, and the results of each year's sample data set were analyzed to estimate the percentage of stream miles supporting aquatic life use for each basin. This approach allows IDEM to make statistically valid estimates of aquatic life use support for a large geographic area (e.g. a basin) with a relatively small number of representative samples. This probability-based approach to water quality monitoring and assessment as well as its advantages and limitations are described in more detail in the section on Surface Water Assessment.

Primary Contact Use

Primary contact refers to direct contact during recreational exposure to surface water (swimming, wading, or other direct contact). IDEM relied primarily on *E. coli* sampling results in making primary contact suitability assessments.

Table 19. IDEM's 2006 303(d) List of Impaired Water bodies for the UTRLA Watershed

Basin	14-Digit HUC	County	Waterbody Segment ID	Waterbody Name	Impairment
Upper Wabash	5120106010010	Whitley	INB0611_00	Tippecanoe River	Dissolved Oxygen *E. coli* Nutrients
Upper Wabash	5120106010010	Whitley	INB06P1001_00	Crooked Lake	FCA for Mercury Impaired Biotic Communities

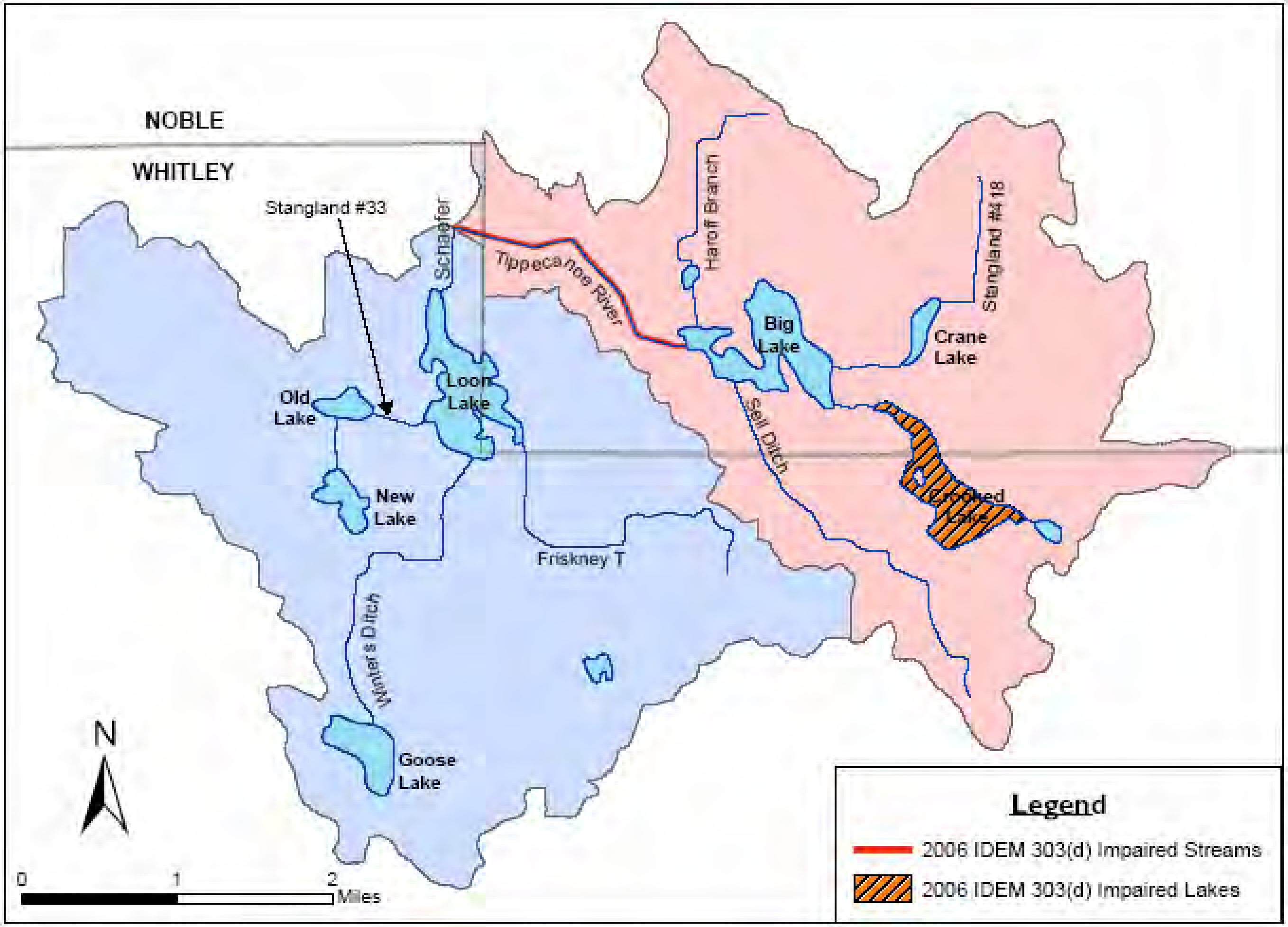

Figure 39: Impaired Lakes and Streams within the UTRLA Watershed (Indiana GIS Map using IDEM Data)

5.1.2 Design Report, Inspection Plan, Operation and Maintenance Plan, and Post Construction Monitoring Plan – Crooked Lake (October 1995)

The DNR Lake Enhancement Program funded the design and the development of the associated maintenance and monitoring plans of a wetland area/sediment basin north of Little Crooked Lake and east of State Road 9 (Subwatershed K). The creation of the basin would involve constructing an earthen berm near State Road 9, impounding surface flow before it enters Farm Ditch. The berm would create a 2.4 acre basin which would function as a sediment basin and as a wetland area for the removal of nutrients.

Also included in this project was streambank stabilization on 400 feet of Farm Ditch downstream of State Road 9 and the placement of a gabion drop structure approximately 415 feet downstream of the State Road 9 culvert. The side slopes would be pulled back from 1:1 to 2:1 slopes and revegetated with erosion control blankets and plant plugs. The drop structure reduces velocity, and therefore, erosion where Farm Ditch has a steep grade.

5.1.3 Design Report, Inspection Plan, Operation and Maintenance Plan, and Post-Construction Monitoring Plan – Loon Lake (December 1997)

The DNR Lake Enhancement Program funded the design and the development of the associated maintenance and monitoring plans of a series of sediment basins and wetland areas along Friskney Ditch prior to entering Loon Lake. A total of 2.0 acres of sediment basin/wetland areas would be created for the purpose of removing sediment and nutrients from the Ditch before it enters Loon Lake.

5.1.4 A Preliminary Assessment of Big Lake, Noble County (1992-1995)

This study conducted water quality sampling and an assessment of the Big Lake Watershed. Big Lake scored 64 points on the IDEM Eutrophication Index, which makes it Class III (lowest quality). The aquatic plant assessment found that curly leaf pondweed and watermilfoil, both invasive species; dominated the stand of plants along shorelines. Bluegreen algae constituted 98 to 99 percent of the phytoplankton collected in 1990 and 1992, indicating the lake was receiving moderately high levels of nutrient runoff, soil erosion, and sewage inputs. The watershed assessment found that Stuckman Branch contained the highest amounts of nitrogen, phosphorus, and TSS during stormflow compared to the other tributaries in the watershed. Pollutant load modeling indicated that agricultural land contributed the vast majority of the phosphorus load from the watershed, while septic systems were the second highest source. Crane Lake was another source of phosphorus to Big Lake with high levels of phosphorus in soluble form present in its hypolimnion. Recommendations made in this study were to reduce internal phosphorus loading by sealing alum, chemical treatment of exotics along shorelines (especially east and north shores) to improve recreation, implementation of agricultural buffers and conservation tillage, streambank stabilization and retention basins, septic maintenance or install sewers, restore and enhance natural areas, protect and restore wetlands, and install buffers between residential lawns and lakes/streams.

5.1.5 Assessment of Watershed – Lake Interactions Influencing the Cultural Eutrophication of Little Crooked and Crooked Lakes, Indiana (April 1993)

This study examined the Crooked and Little Crooked Lakes Watershed to determine the watershed sources causing the cultural eutrophication occurring in these lakes. In 1975, Crooked Lake had an IDEM Eutrophication Index (EI) of 3, making it the second healthiest lake in Indiana. In 1987, it had an IDEM EI of 12, which is still a Class One, but significantly more degraded in comparison to 12 years earlier. Crooked Lake also had one of the healthiest Cisco populations in the state, but in 1980 the population began to display clear signs of stress. Water quality sampling in October 1990 identified elevated concentrations of Ammonia, Total Kjeldahl Nitrogen, Total Phosphorus, and Total Orthophosphorus, especially in Little Crooked Lake. Based on the October 1990 sampling, the IDEM EI for Crooked Lake was 40 (Class Two) and 54 (Class Three – worst class) for Little Crooked Lake. Secchi disk readings taken at the same time were characteristic of moderate to good water quality in Crooked Lake and moderately eutrophic in Little Crooked Lake. An aquatic plant survey conducted in August 1990 determined that neither Crooked nor Little Crooked Lakes had a macrophyte problem. The study did report, however that emergent vegetation along the shoreline of these lakes had almost disappeared by 1981. Emergent vegetation provides fish breeding grounds, acts as a sponge to absorb nutrients entering the watershed and adjacent residential lawns, and also serves as a buffer against and a wave energy dissipater for shoreline erosion.

The watershed is primarily agriculture and mostly drains into Little Crooked Lake which then drains into Crooked Lake. The study cited agriculture as the predominate source of sediment and nutrients into Little Crooked Lake and into the portion of Crooked Lake nearest Little Crooked Lake. From 1951 to 1987 residential development was on the rise, possibly accounting for the loss of shoreline vegetation and nutrients being loaded into Crooked Lake.

5.1.6 Crooked Lake, Noble – Whitley Counties, Cisco Population Status (2005)

This study conducted by IDNR – Division of Fish and Wildlife (DFW) classified Crooked Lake as one of the 13 lakes in Indiana that still contained ciscoes, a fish very sensitive to habitat degradation. The cisco population in Crooked Lake, however, has been diminishing slowly since the early 1980s. This corresponds with the previous study described in Section 5.1.5, which explains how Crooked Lake had been experiencing degradation of its water quality since 1980 or earlier. There had been significant cisco kills following significant rainfall events in 1981, 1986, and 2000, and smaller cisco kills following less significant rain events (Pearson, IDNR fisheries biologist). IDNR efforts to protect cisco habitat have included, limiting shoreline alterations, limiting herbicide use, protecting the north shore from development, implementing better watershed management practices, installing a sewer system, and the discontinuation in the stocking of predators of cisco, brown trout (1985) and rainbow trout (1995).

5.1.7 Feasibility Studies of Loon Lake and Goose Lake (March 1992)

Water quality sampling conducted as part of this study and past studies showed Loon Lake to be in an advanced eutrophic state (Class III), while Goose Lake was in an intermediate to advanced eutrophic state (Class II/III). The pollutant loads from the watershed were entirely from nonpoint sources. A pollutant load reduction of 90% was determined to be necessary in order to improve water quality to mesotrophic levels in Loon Lake, and 85% in Goose Lake. This study explored the feasibility of numerous strategies and practices that reduce pollutant loads. Those that were deemed feasible for this watershed included agricultural BMPs, homeowner practices, streambank and roadway stabilization, wastewater management, impoundment ponds, an aquatic plant management plan, and the development of a watershed management district with taxing powers. The agricultural BMPs included but were not limited to conservation tillage, buffer strips, cover crops, grassed waterways, and terraces. The homeowner practices deemed feasible included septic system maintenance, minimization of fertilizer use, reseeding exposed soil, and the creation of vegetated buffers between lawn and lake/stream. Both vegetative and structural streambank and roadway stabilization was recommended. The study also recommended that a wastewater feasibility study be conducted to further assess the possibility of land application of the effluent. A 12 acre impoundment pond/sediment trap that is an average of 3.5 feet deep constructed on Friskney Ditch close to where it outlets to Loon Lake was deemed feasible and was projected to remove 90% of the sediment and 60% of the Phosphorus carried by the ditch and loaded into Loon Lake. Mechanical harvesting, hand-pulling, and installation of bottom barriers were practices deemed feasible and effective when combined into an aquatic plant management plan. A combination of some of these practices and strategies would be required to improve the water quality in Loon and Goose Lakes to mesotrophic levels.

5.1.8 Upper Tippecanoe River Watershed Management Plan, Kosciusko, Noble, and Whitley Counties, Indiana (July 2006)

An IDEM 319 watershed management plan for the Upper Tippecanoe River Watershed was developed in 2002, and was revised in 2006 to meet IDEM's expanded requirements of the 2003 checklist. The Upper Tippecanoe River Watershed was broken down into eight 14-digit HUC subwatersheds. Based on water quality data, the Tippecanoe River – Crooked Lake/Big Lake subwatershed ranked fifth and the Loon Lake – Goose Lake/Old Lake subwatershed ranked sixth out of the eight subwatersheds, with one being the worst water quality and eight being the best. Recommendations for the entire Crooked/Big Lakes Watershed included conducting a more detailed diagnostic study of this subwatershed and continue in-lake water quality testing and consider tributary sampling. Recommendations for the subwatersheds of the Crooked/Big Lakes Watershed included grade control/stabilization and conservation tillage in the Crooked Lake subwatershed (J). Constructing sediment traps, expanding idle lands, reforesting land, installing filter strips, and stabilizing banks was recommended in the Big Lake/Green Lake/Stuckman Ditch subwatershed (H). Constructing sediment traps and installing filter strips was recommended in the Sell Branch subwatershed (I), while installing filter strips, reforesting land, and constructing sediment traps was recommended in the Crane Lake subwatershed (L). Recommendations for the Loon/Goose Lakes Watershed were to conduct a more detailed diagnostic study and to work with livestock owners to develop waste storage structures.

5.1.9 IDNR Fisheries Studies

IDNR conducts fisheries studies in the lakes of Indiana every several years. A fish survey or assessment was not completed as part of this study; however, the IDNR Fisheries Biologist, Jed Pearson, completed a fish assessment based on IDNR fisheries studies conducted in the lakes of the watershed. Pearson presented the results of this assessment at the July 12th, 2007 public meeting. Table 20 summarizes the fishing quality of the lakes in the UTRLA Watershed based on fish size and abundance.

Table 20. Fishing Summary of the UTRLA Watershed Lakes

Lake	Bluegill	Bass	Crappie	Perch
Big	Good	Good	Poor	Fair
Crane	Good	Fair	Fair	Poor
Crooked	Good	Fair	Poor	Good
Goose	Good	Fair	Poor	Good
Loon	Poor	Fair	Fair	Fair
New	Fair	Fair	Good	Good
Old	Good	Good	Poor	Poor

Sunfish, muskies, ciscoes

5.2 WATER QUALITY SAMPLING IN THE UTRLA WATERSHED

Water chemistry sampling, *E. coli* sampling, macroinvertebrate sampling, habitat evaluations, and an assessment of in-lake sampling was conducted by Commonwealth Biomonitoring as part of this study. A copy of the water quality report conducted by Commonwealth Biomonitoring is included as Appendix C. Sampling site locations in the UTRLA Watershed are listed in Table 21 and shown on Figures 40 and 41. Photos of the sampling site locations are included as Appendix D. Table 22 lists the healthy limits for water quality parameters tested as part of this study.

Table 21. Sampling Sites in the UTRLA Watershed

Sampling Site	Waterway	Subwatershed	Latitude	Longitude
1	Crane Lake Inlet	L	41.16.46	85.28.45
2	Loon Lake Inlet 1(Friskney Ditch)	F	41.15.28	85.31.47
3	Loon Lake Inlet 2 (Winters Ditch)	E	41.15.14	85.33.11
4	Little Crooked Lake Inlet (Farm Ditch)	K	41.15.48	85.27.48
5	Green Lake Inlet (Haroff Branch)	H	41.17.15	85.30.36
6	Big Lake South Inlet (Sell Ditch)	I	41.16.12	85.30.16
7	Crooked Lake West Inlet	J	41.15.29	85.29.01
8	Crooked Lake South Inlet	J	41.15.22	85.28.24
9	Big Lake North Inlet (Stuckman Ditch)	H	41.16.57	85.30.01
10	Goose Lake Inlet	E	41.14.07	85.32.32
11	Old Lake South Inlet	A	41.16.12	85.33.32
12	Old Lake North Inlet	B	41.16.19	85.33.31
13	Loon Lake West Inlet 1	C	41.16.42	85.32.40
14	Loon Lake West Inlet 2	C	41.16.35	85.32.40

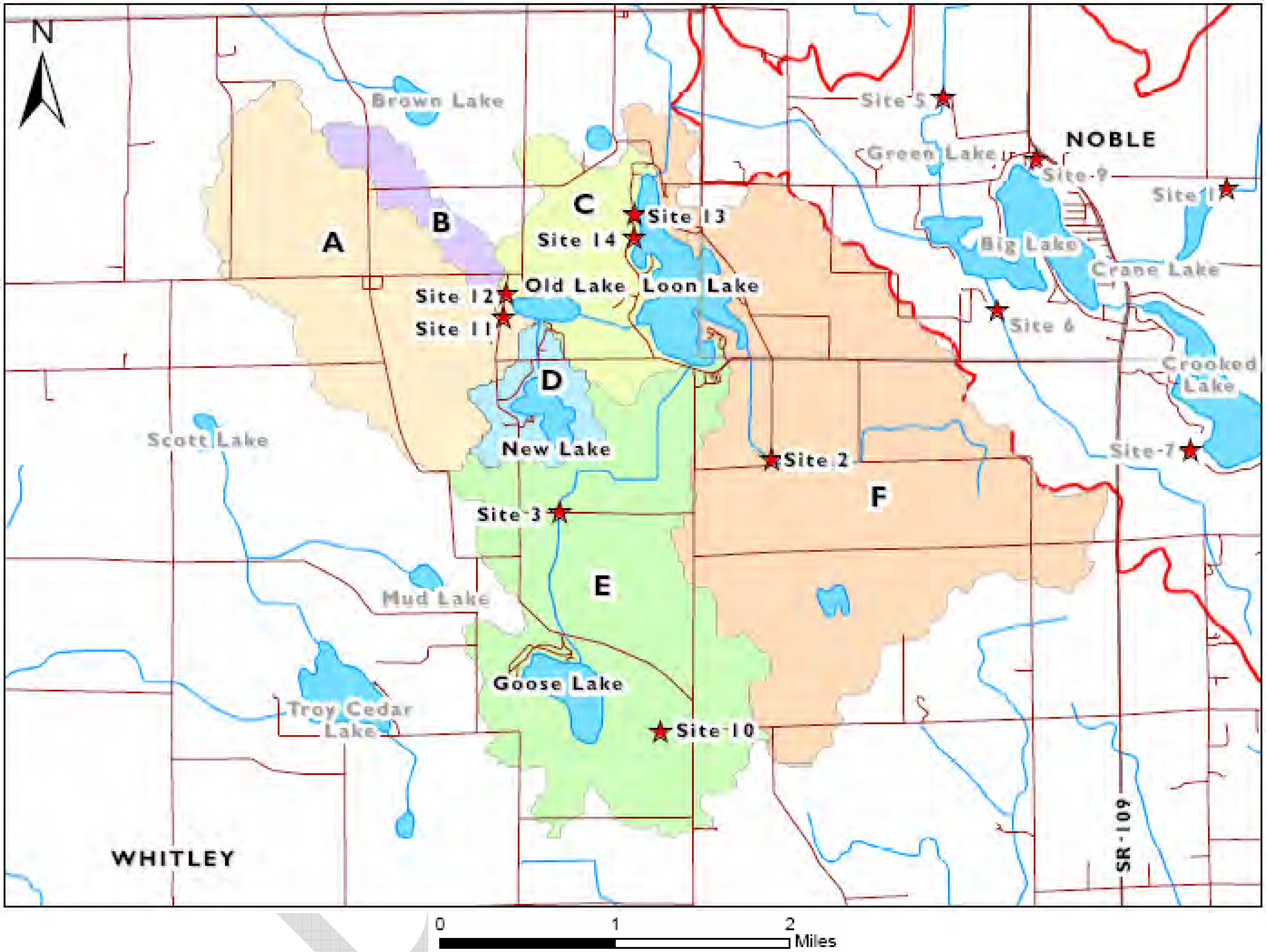

Figure 40. Sampling Sites in the Loon Lake – Goose Lake/Old Lake Watershed

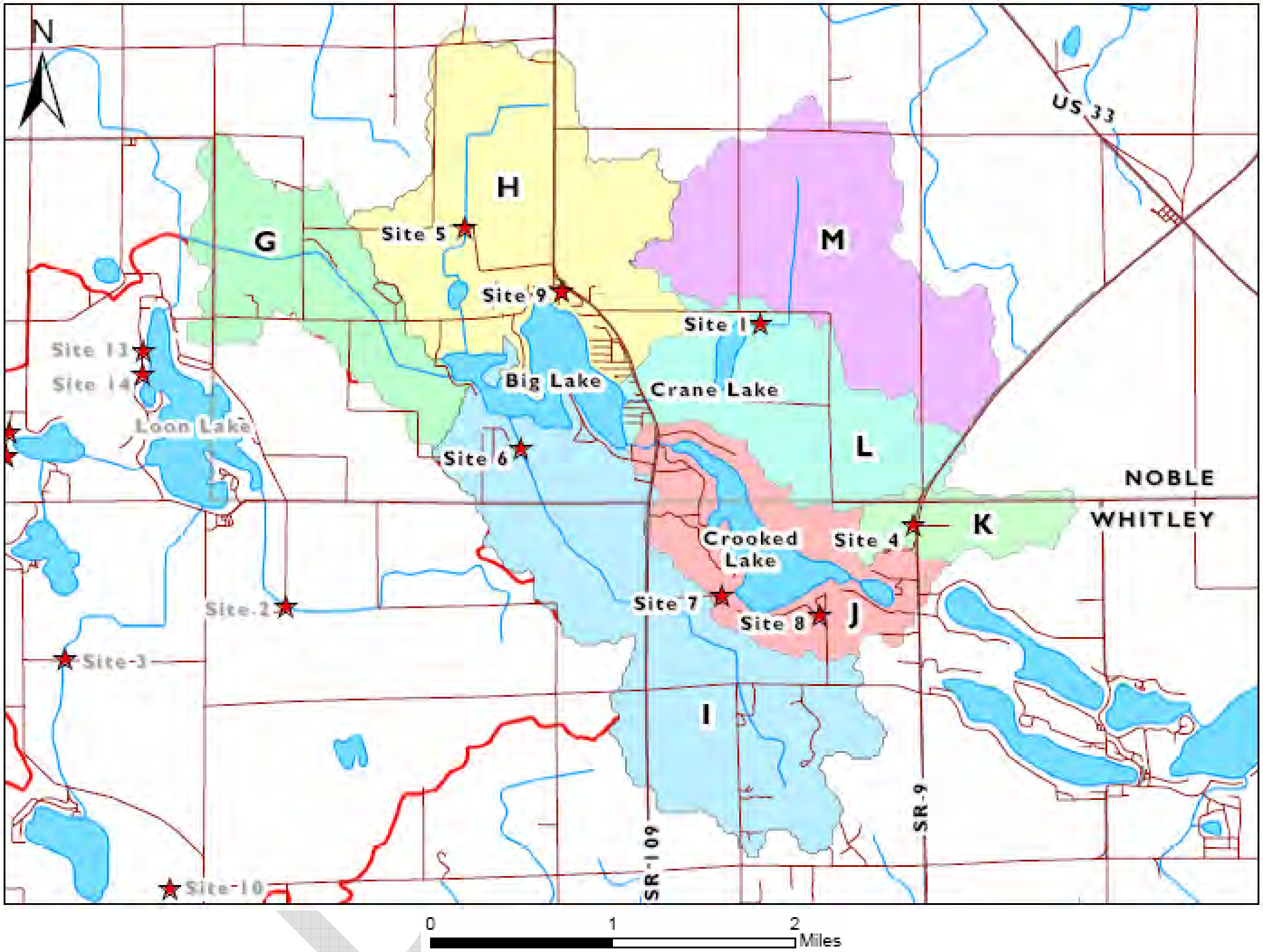

Figure 41. Sampling Sites in the Tippecanoe River – Crooked Lake/Big Lake Watershed

5.2.1 Tributary Water Chemistry Sampling

The chemical and physical sampling parameters included Total Phosphorus (TP), Orthophosphorus (Ortho-P), Nitrate (NO3), Ammonia (NH3), Total Kjeldahl Nitrogen (TKN), Total Suspended Solids (TSS), Dissolved Oxygen (DO), pH, Conductivity, and temperature. The sampling was conducted on January 1 and 24, 2007, June 6, 2007 (base flow conditions), and August 7, 2007 (storm flow conditions). Water samples for laboratory analysis were collected in polyethylene plastic containers, preserved in the field where appropriate, and returned to the Commonwealth Biomonitoring laboratory for analysis. Analysis of DO, pH, temperature, and conductivity were made on location using field instruments. Sampling sites 13 and 14 were not sampled in June because they did have any flow during baseflow conditions. Base flow results are shown in Table 23 and storm flow results are shown in Table 24.

<u>Total Phosphorus (TP)</u>

Phosphorus is a nutrient essential to plant growth and therefore can cause algal blooms and contribute to the eutrophication of the lake. Sources of phosphorus to streams and lakes are fertilizers, human and animal wastes, and yard waste. Phosphorus cannot be fixed from the atmosphere like nitrogen; therefore it is often the limiting nutrient for plant growth in aquatic systems. Greg Bright, Commonwealth Biomonitoring, stated that TP should be maintained below 0.1 mg/L to prevent eutrophication. All the tributaries exceeded this level during baseflow conditions, and during stormflow conditions Winters Ditch (E), Haroff Branch (H), the Crooked Lake West Inlet (J), and Stuckman Ditch (H) exceeded 0.1mg/L. During baseflow conditions Friskney Ditch (F), Haroff Branch (H), and Stuckman Ditch (H) had the highest TP levels, while during stormflow conditions Stuckman Branch (H), Winters Ditch (E), and the Crooked Lake West Inlet (J) had the highest levels.

<u>Orthophosphorus (Ortho-P)</u>

The most important form of phosphorus in determining the ecological health of a lake is Orthophosphorus Ortho-P). It is the dissolved form that is most easily taken up by aquatic plants and algae. Ortho-P should also be maintained below 0.1 mg/L to prevent eutrophication (Bright, Commonwealth Biomonitoring). This level was exceeded by most of the sites during baseflow and by Winters Ditch (E), Crooked Lake West Inlet (J), and Stuckman Ditch (H). Friskney Ditch (F), Haroff Branch (H), Sell Ditch (I), Crooked Lake West Inlet (J), and the Goose Lake Inlet (E) had the highest Ortho-P values during baseflow, while Stuckman Ditch (H), Winters Ditch (E), and the Crooked Lake West Inlet (J) had the highest values during stormflow.

<u>Nitrate (NO3)</u>

Nitrate (NO3) is an oxidized form of dissolved nitrogen. The nitrogen in fertilizers rapidly oxidizes and becomes nitrate which is transported to waterways by runoff. NO3 is also a byproduct of the decomposition of human and animal waste. Septic systems and animal manure are, therefore, common sources of nitrates in aquatic systems. NO3 is used for plant growth and can therefore cause algal blooms. During high primary production NO3 levels are frequently less than 1 mg/L. Crane Lake Inlet (L), Stuckman Ditch (H), and Sell Ditch (I) had the highest baseflow NO3 levels, while the Crane Lake Inlet (L), Winters Ditch (E), the Crooked Lake West Inlet (J), and the Loon Lake West Inlet (C) had the highest stormflow values.

<u>Ammonia (NH3)</u>

Ammonia (NH3) is a form of dissolved nitrogen that is the preferred form for algal use. It is a byproduct of plant and animal decomposition and is found in water where DO is lacking. Common sources of ammonia in aquatic systems are fertilizers, animal manure, and septic systems. Non-polluted streams usually have NH3 levels of less than 1 mg/L. None of the tributaries in the UTRLA Watershed exceeded this level during baseflow, however, during stormflow Stuckman Ditch (H), Old Lake North Inlet (B), and Loon Lake West Inlet (C) exceeded 1 mg/L. The highest baseflow NH3 values were at Haroff Branch (H), Stuckman Ditch (H), and Friskney Ditch (F), while the highest stormflow values were at the Old Lake North Inlet (B), the Loon Lake West Inlet (C), and Stuckman Ditch (H).

Total Kjeldahl Nitrogen (TKN)

Total Kjeldahl Nitrogen (TKN) is the sum of organic nitrogen and NH3 in a waterbody. Animal manure and septic systems are common sources of TKN. TKN should not exceed 2 mg/L to protect aquatic life. None of the sampling sites exceeded this level during baseflow or stormflow conditions. The highest values of TKN were at Friskney Ditch (F), Haroff Branch (H), the Crane Lake Inlet (L), the Crooked Lake South Inlet (J), and Stuckman Ditch (H) during baseflow, and at Stuckman Branch (H), the Old Lake North Inlet (B), and Friskney Ditch (F) during stormflow conditions.

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) is the measure of the suspended particles in water, including sediment and other solid compounds. The sediment and other solids are typically picked up by overland flow and deposited in the nearest waterbody. They add to the turbidity of the water, blocking out light needed for plant growth. When water flow slows down, the particles settle to the bottom, smothering bottom-dwelling organism and slowly filling in the waterbody. TSS can also change the temperature and DO in a waterbody, consequently affecting aquatic organisms. Under a moderate level of protection, TSS concentrations should be 80 mg/L, while under a high level of protection they should be less than 25 mg/L. These concentrations were not exceeded during baseflow conditions. During stormflow conditions the Crane Lake Inlet (L) and Stuckman Ditch (H) exceeded 25mg/L, but remained well under 80 mg/L. During baseflow, the Crooked Lake South Inlet (J), Friskney Ditch (F), and Sell Ditch (I) had the highest TSS values, while the Crane Lake Inlet (L), Friskney Ditch (F), and Farm Ditch (K) had the highest stormflow values.

Dissolved Oxygen (DO)

Dissolved Oxygen (DO) is a measure of the amount of oxygen available for biological respiration by fish and other aquatic organisms. It is essential for the respiration of fish and other aquatic organisms. The healthy concentration of DO is 5 to 10 mg/L. Concentrations remaining below 5 mg/L for periods of time cause death of aquatic species, but if the concentration is much higher than 10 mg/L the water may become super saturated. Super saturation occurs when oxygen is being added to the water, by algal blooms for example. DO enters the water by diffusion from the atmosphere and as a byproduct of photosynthesis. The low DO levels at the Crooked Lake inlets during the June "baseflow" sampling event were due to lack of flow in pooled areas rather than specific water pollution problems. Sell Ditch (I) had DO values which were well over the healthy level during both base and storm flows, indicating super saturation. Haroff Branch (H), Stuckman Ditch (H), and the Old Lake South Inlet (A) had low DO levels during stormflow.

pH

pH is the measure of the acidic or basic nature of a solution. The pH in an aquatic system determines the toxicity of other pollutants present in the system. A pH range of 6.0 to 8.3 is recommended to protect aquatic life. Values greater than 8.3 often indicate high algal productivity associated with excessive nutrient inputs. High values were recorded during base flow at Sell Ditch (I) and the Goose Lake Inlet (E).

Conductivity

Conductivity is a measure of total dissolved solids in the water. The higher the reading, the more particles are dissolved in the water. The recommended level to protect aquatic life is 2000 uS. Toxicity effects from too many dissolved ions may occur when conductivity exceeds 2000 uS. Conductivity was within normal values in the UTRLA Watershed, indicating low dissolved solids at all sites.

Temperature

Temperature regulates the composition and activity of all aquatic life. It also affects the solubility and therefore the toxicity of pollutants present in an aquatic system. DO is directly related to temperature, the colder the water, the higher the DO concentration. Temperatures up to 19°C (66°F) are optimal for coldwater fish, while temperatures below 31°C (87°F) are optimal for warmwater fish. Summer base flow samples in the UTRLA Watershed had relatively low temperatures (less than 20 degrees C) at many sites. This usually indicates the strong influence of groundwater inputs. Groundwater inflow was especially noticeable at the Crane Lake Inlet (L), the Crooked Lake West Inlet (J), Stuckman Ditch (H), and the Old Lake North Inlet (B).

Table 22. Water Quality Parameter Limits

Parameter	Limit
Total Phosphorus (TP)	0.1 mg/L
Orthophosphorus (Ortho-P)	0.1 mg/L
Nitrate (NO3)	1.0 mg/L
Ammonia (NH3)	1.0 mg/L
Total Kjeldahl Nitrogen (TKN)	2.0 mg/L
Total Suspended Solids (TSS)	80 mg/L
Dissolved Oxygen (DO)	5 – 10 mg/L
pH	6.0 – 8.3
Conductivity	2000 uS
Temperature	Less than 19°C (66°F)

Table 23. June 6, 2007 Water Chemistry in the UTRLA Watershed (Baseflow)

Sampling Site	Subwatershed	Tributary	Flow	TP	Ortho-P	NO3	NH3	TKN	TSS	D.O.	pH	Cond.	Temp.
			cfs	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	SU	uS	C
1	L	Crane Lake Inlet	0.18	0.5	0.1	3.5	0.32	0.8	7	11.0	7.9	680	15.8
2	F	Friskney Ditch	0.80	2.7	0.65	1	0.55	1.2	17.5	11.2	8.0	580	22.0
3	E	Winters Ditch	1.60	0.46	0.1	1.6	0.32	0.6	5	12.0	8.2	560	21.0
4	K	Farm Ditch	0.08	1.4	0.14	1	0.4	0.5	8	5.6	7.5	1080	18.2
5	H	Haroff Branch	0.16	2.2	0.52	5	0.85	0.9	8	11.2	8.2	660	26.5
6	I	Sell Ditch	1.36	0.35	0.3	2.1	0.35	0.4	14.5	18.7	8.5	810	25.9
7	J	Crooked Lake West Inlet	0.04	0.46	0.3	0.8	0.2	0.4	5	3.7	7.3	1070	12.5
8	J	Crooked Lake South Inlet	0.06	0.28	0.08	0.6	0.19	0.8	22	1.5	7.2	560	14.8
9	H	Stuckman Ditch	0.48	1.4	0.14	2.8	0.75	0.8	15	6.9	7.5	710	16.8
10	E	Goose Lake Inlet	0.08	0.35	0.3	0.5	0.48	0.5	6.5	11.9	8.6	350	22.3
11	A	Old Lake South Inlet	0.18	0.4	0.14	0.9	0.4	0.6	2.5	13.0	8.0	640	21.2
12	B	Old Lake North Inlet	0.10	0.5	0.14	1.3	0.6	0.6	7.5	7.2	7.7	780	16.5

Table 24. August 7, 2007 Water Chemistry in the UTRLA Watershed (Stormflow)

Sampling Site	Subwatershed	Tributary	Flow	TP	Ortho-P	NO3	NH3	TKN	TSS	D.O.	pH	Cond.	Temp.
			cfs	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	SU	uS	C
1	L	Crane Lake Inlet	0.59	0.1	0.05	1.8	0.7	0.7	25.5	5.0	6.9	590	20.0
2	F	Friskney Ditch	2.70	0.02	0.01	0.6	0.9	1.3	12.5	10.5	7.6	580	28.5
3	E	Winters Ditch	5.40	0.4	0.3	1.3	0.9	0.9	6.5	8.4	7.2	570	27.9
4	K	Farm Ditch	0.27	0.04	0.03	0.3	0.6	0.8	11.5	6.2	7.4	930	23.2
5	H	Haroff Branch	0.54	0.12	0.07	0.9	0.9	0.9	6	3.4	7.0	640	25.8
6	I	Sell Ditch	4.59	0.06	0.01	0.3	0.7	0.7	6.5	18.7	8.0	680	28.0
7	J	Crooked Lake West Inlet	0.14	0.3	0.15	1.2	0.7	0.7	13	5.4	7.0	340	22.6
8	J	Crooked Lake South Inlet	0.19	0.08	0.06	0.6	0.9	0.9	4.5	5.0	6.9	630	25.9
9	H	Stuckman Ditch	1.62	1.1	0.8	1.1	1.1	1.7	28	4.4	6.9	1000	21.4
10	E	Goose Lake Inlet	0.27	0.1	0.05	0.3	0.8	0.8	10	6.0	7.2	620	29.0
11	A	Old Lake South Inlet	0.59	0.1	0.07	0.3	0.7	0.7	2.5	4.7	7.0	580	26.8
12	B	Old Lake North Inlet	0.32	0.08	0.07	0.3	1.3	1.5	4	5.3	7.2	630	21.5
13	C	Loon Lake West Inlet	0.1	0.05	0.04	1.2	1.3		5.5				
14	C	Old Lake inlet to Loon Lake	1	0.02	0.01	0.3	0.9		3.5				
Duplicate	H	Haroff Branch duplicate		0.13	0.08	0.8	0.9		6				

5.2.2 *E. coli* Sampling

E. coli is one member of the fecal coli form bacteria group, and indicates the presence of pathogens in a water sample. Pathogenic organisms cause a variety of serious diseases, and therefore, pose a serious threat to human health. *E. coli* can come from the feces of any warm-blooded animal. Wildlife, livestock, and domestic animal defecation; manure fertilizers; previously contaminated sediments; and failing or improperly sited septic systems are common sources of the bacteria. *E. coli* was sampled at six of the sampling sites during the June 6, 2007 baseflow conditions (Table 25), and at three sites during an October 18, 2007 storm event (Table 26). Concentrations were near or below the Indiana water quality standard of 235 colonies/100ml for swimming at all sites except the Loon Lake West Inlet during storm flow.

Table 25. June 6, 2007 *E. coli* Levels in the UTRLA Watershed (Baseflow)

Sampling Site	Subwatershed	Tributary	Flow cfs	*E. coli* (baseflow) colonies/100 mL
1	L	Crane Lake Inlet	0.18	240
2	F	Friskney Ditch	0.80	4
3	E	Winters Ditch	1.60	186
6	I	Sell Ditch	1.36	59
10	E	Goose Lake Inlet	0.08	14
11	A	Old Lake South Inlet	0.18	38

Table 26. October 18, 2007 *E. coli* Levels in the UTRLA Watershed (Stormflow)

Sampling Site	Subwatershed	Tributary	Flow cfs	*E. coli* (baseflow) colonies/100 mL
11	A	Old Lake South Inlet	0.5	151
12	B	Old Lake North Inlet	0.5	185
13	C	Loon Lake West Inlet	0.4	508

5.2.3 Macroinvertebrate Sampling

Macroinvertebrate monitoring is a valuable tool to measure the ecological health of a stream. Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change, benthic (bottom-dwelling) organisms are considered to be the primary tool to document the biological condition of the streams. The numbers and kinds of animals present at a study site can be compared to an unimpacted reference site. The Little Wabash River at Broadway Street in Huntington was chosen as the reference in this study. It represents other nearby streams in this ecoregion and previous biological sampling by IDEM (unpublished AIMS data) showed that the biotic index value is among the highest in the immediate area. The bioassessment technique compared the community of the reference site with each study site. Higher biotic index values indicate more ecologically healthy streams.

Macroinvertebrate samples in this study were collected by dipnet in riffle areas where speeds approached 30 cm/sec. All samples were preserved in the field with 70% isopropanol. Samples were collected on May 8 and 10, 2007.

In the laboratory, a 100 organism subsample was prepared from each sampling site by evenly distributing the animals collected in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species) using standard taxonomic references (Simpson, 1980, Schuster, 1978, and Merritt, 1996). As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection. A total of 45 macroinvertebrate genera were found during the study. Predominant forms included midge larvae (Chironomidae) and blackfly larvae (Simuliidae). The list of specimen found at each sampling site is included as Table 27.

Following identification of the animals in the sample, "metrics" were calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions. The macroinvertebrate data from this study were analyzed by four different sets of metrics (Table 28 and Figure 42). Data were analyzed with the mIBI protocol developed by the IDEM (1999), an adaptation of the Ohio EPA protocol (Ohio EPA, 1987), the original Lake and River Enhancement (LARE) program metrics recommended by EPA Bioassessment Protocol 3 (Plafkin, 1989), and a set of metrics developed later by the US EPA (US EPA, 1999). Each assessment protocol compared the aquatic community of study sites to a “reference” condition. A reference site is a stream of similar size in the same geographic area that is least impacted by human changes in the watershed. The reference stream in this study (the Little Wabash River near Huntington) had been identified previously as a nearby stream with high biotic integrity (IDEM, unpublished data from the AIMS database). To allow better comparisons between each scoring system, the scores reported below were all normalized to a percentage of the highest possible score.

An evaluation of the macroinvertebrate bioassessment scores by the different protocols showed variation in ranking of sites from best to worse, but some patterns emerged. Green Lake inlet consistently scored poorly. This site had an unbalanced benthic community dominated by blackfly larvae. Old Lake South inlet also scored poorly, as its benthic community was dominated by a sediment-tolerant species of midge larvae (*Orthocladius obumbratus*).

Sites that had the highest biotic index scores, despite having less than desirable habitat scores, included Crooked Lake west inlet, Old Lake north inlet, and Sell Ditch draining into Big Lake from the south. These sites had more balanced benthic communities, including the intolerant groups of mayflies, stoneflies and caddisflies.

Table 27. May 8 and 10, 2007 Macroinvertebrate Samples from the UTRLA Watershed

		Site Number												
		Ref.	1	2	3	4	5	6	7	8	9	11	12	6
Ephemeroptera (Mayflies)	Stenacron interpunctatum	5												
	Stenonema terminatum	2												
	Baetis hageni												11	
	B. flavistriga												2	
	Caenis spp.	1		4				39			4			39
Trichoptera (Caddisflies)	Limnephilidae								3					
	Hydropsyche betteni												8	
	Cheumatopsyche spp.	37			3	1		3			7		25	3
	Ceratopsyche bifida	3												
	Chimarra obscura	1												
Plecoptera (Stoneflies)	Perlidae				2			1						1
	Amphinemura spp.								58					
	Capnidae				3									
Coleoptera (Beetles)	Stenelmis spp.	17						1			15			1
	Optioservius fastiditus	3												
	Dubiraphia spp.				1									
	Dytiscidae		4		3		1	2	6	8		1	1	2
Odonata (Damsel & Dragonflies)	Argia spp.			1	3					1	1			
	Boyeria spp.		1											
Diptera (Flies)	Simulidae					79	81		2	2	1		21	
	Ephydridae				1				3					
	Ceratopoginae			1										
	unknown dipteran pupa			4										
	Tipula spp.												2	
	Pseudolimnophila spp.										1			

Table 27 (cont'd). May 8 and 10, 2007 Macroinvertebrate Samples from the UTRLA Watershed

Chironomidae (midges)	Thienemannimyia spp.	3		5	10			2					2	2
	Procladius spp.			3										
	Cricotopus bicinctus	2	12	13		2		16	2		9		2	16
	C. sylvestris	4	3											
	Orthocladius obumbratus	10	27	27		12	13	18	6		10	79	4	18
	Cardiocladius spp.								2					
	Nanocladius spp.			3		2		2						2
	Eukiefferiella pseudomontana		4											
	Thienemanniella xena								3					
	Glyptotendipes lobiferus			3										
	Polypedilum convicturm	11	4		6					31			14	
	Dicrotendipes spp.		3							3				
	Paratendipes albimanus		8					4						4
	Endochironomus nigricans									4				
	Microspectra polita			5	10				8	31		7		
	Tanytarsus guerlus		8	5		1	5				1		6	
Crustacea	Isopoda		8		1						2	10	2	
	Amphipoda		17	2	3			4	6	17	47	1		4
Annelida	Hirudinea			12				1		3	2	1		1
	Oligochaetes	1	1	12	1	3		3	1			1		3
Mollusca	Sphaeridae				53			4						4
TOTAL		100	100	100	100	100	100	100	100	100	100	100	100	100

Table 28. Results of Macroinvertebrate Bioassessment in the UTRLA Watershed

	Site Number											
	Ref	1	2	3	4	5	6	7	8	9	11	12
mIBI	90	30	37	60	32	30	80	82	27	65	37	67
Ohio EPA	78	45	45	50	45	22	55	55	55	55	28	88
LARE	100	56	51	58	37	27	66	100	63	63	27	78
US EPA	100	20	24	40	24	16	44	32	24	48	20	72
Average	92	38	39	52	34	24	61	67	42	58	28	76

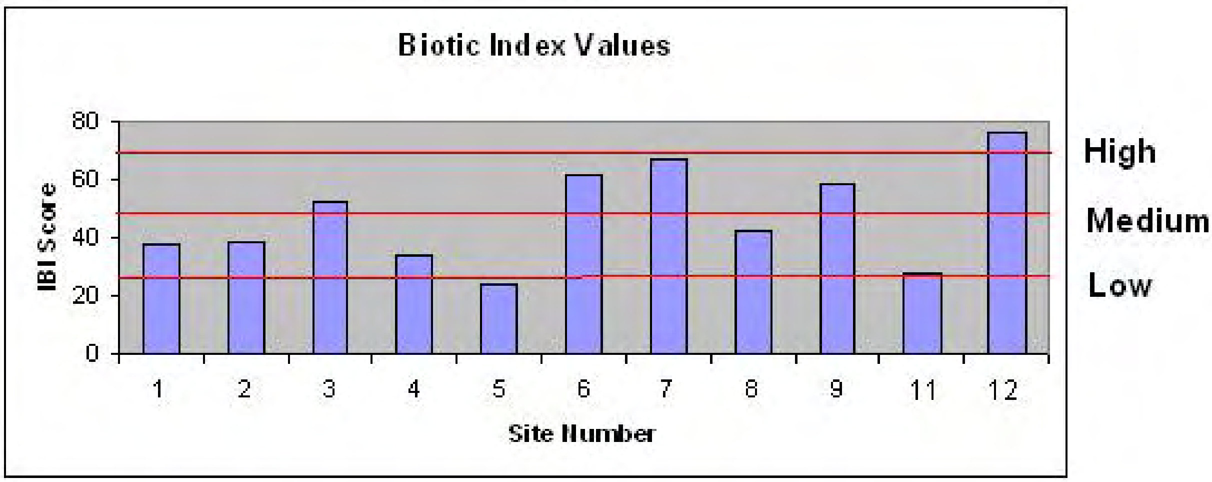

Figure 42. Results of the Macroinvertebrate Bioassessment in the UTRLA Watershed

5.2.4 Habitat Evaluations

The aquatic habitat at each study site was evaluated according to the method described by Ohio EPA (Ohio EPA, 1987). This Qualitative Habitat Evaluation Index (QHEI) assigns values to various habitat parameters (e.g. substrate quality, riparian vegetation, channel morphology, etc.), which are then summed to result in a numerical score for each site. Higher scores indicate higher habitat value. The maximum value for habitat using this assessment technique is 100. According to IDEM, sites with a QHEI greater than 64 are fully supporting of aquatic life use, those between 51 and 64 are partially supporting, while those less than 51 are non-supporting.

QHEI values for most of the study sites examined were low. None of the sampling sites in the UTRLA Watershed received a fully supporting score, while only two received partially supporting scores. High quality biotic communities would not be expected in any of these streams. Results of the QHEI are shown in Table 29 and Figure 43.

Table 29. QHEI Results for the UTRLA Watershed

	Sampling Sites										
	1	2	3	4	5	6	7	8	9	11	12
Substrate	9	8	13	9	4	9	15	9	14	12	17
Cover	5	3	5	6	2	3	10	6	6	6	6
Channel	7	7	10	8	6	7	13	8	7	8	9
Riparian	4	5	7	5	3	4	8	5	4	4	4
Pool	4	7	5	5	5	7	5	4	5	5	5
Riffle	3	3	3	2	2	3	3	2	3	1	6
Gradient	6	6	6	8	4	4	8	6	6	6	8
TOTAL	38	39	49	43	26	37	62	40	45	42	55

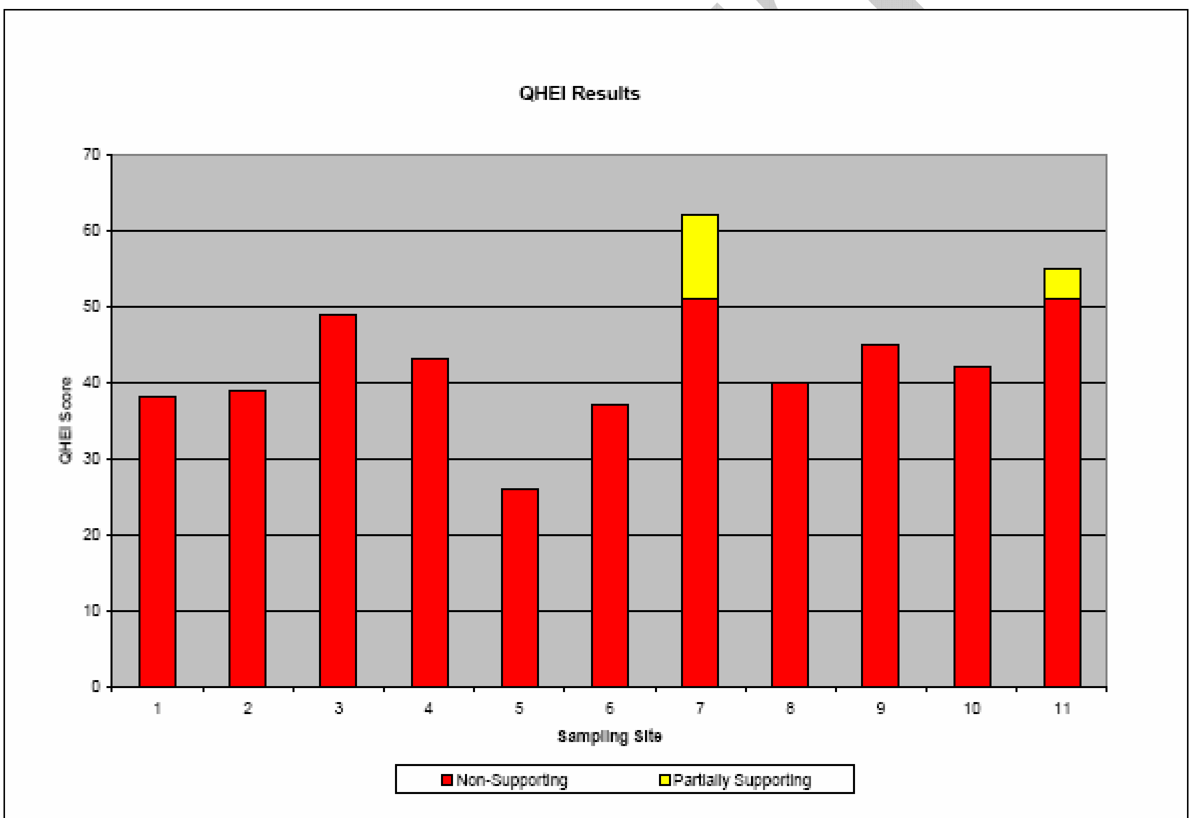

Figure 43. QHEI Results for the UTRLA Watershed

5.2.5 In-Lake Water Chemistry Data

In-lake water chemistry data from 1970 and 2000 was compiled and assessed to gain an understanding of the health of the lakes in the UTRLA Watershed. The parameters assessed were ammonia (NH3-N), nitrate (NO3-N), organic nitrogen (Org-N), total nitrogen (TN), soluble reactive phosphorus (SRP), chlorophyll-a (chl-a), blue-green algal dominance (BG Dom.), and the tropic state index (TSI). A general trend between the 1970 and 2000 data was that the nutrient concentrations in the watershed's lakes have doubled. Crooked, Old, and New Lakes have experienced the greatest decline in water quality, while New and Crooked Lakes are now dominated by blue-green algae, but formerly were not. Table 30 illustrates the IDEM TSI classes, with the oligotrophic class having the best water quality and the hypereutrophic class having the worst water quality. The 1970 water chemistry data is illustrated in Table 31, and the 2000 data is shown in Table 32. Based on the 2000 data, five out of the nine lakes assessed were hypereutrophic, two were eutrophic, two were mesotrophic, and the average of the nine lakes within the UTRLA Watershed was eutrophic (Table 33).

Table 30. IDEM TSI Classes

Class	TSI Score
Oligotrophic	<15
Mesotrophic	16-31
Eutrophic	32-46
Hypereutrophic	>47

Table 31. 1970 Trophic Status Data in the UTRLA Watershed

Lake	NH3-N mg/l	NO3-N mg/l	Org-N mg/l	TN mg/l	SRP mg/l	chl-a	BG Dom.	TSI-1970
Big Lake	0.2	0.6	0.1	0.83	0.17		yes	38
Crooked Lake	0.1	0.2	0.4	0.7	0.03		no	3
Crane Lake	0.3	3	1.3	4.6	0.03		yes	45
Goose Lake	0.1	0.4	0.7	1.2	0.03		yes	61
Green Lake								
Little Crooked Lake	0.4	0.5	0.5	1.4	0.03		yes	32
Loon Lake	0.2	0.6	0.9	1.7	0.04		yes	46
New Lake	0.1	0.1	0.3	0.5	0.03		no	7
Old Lake	0.5	0.1	0.5	1.1	0.1		yes	48
Average	0.2	0.7	0.6	1.5	0.1			35

Table 32. 2000 Trophic Status Data in the UTRLA Watershed

Lake	NH3-N mg/l	NO3-N mg/l	Org-N mg/l	TN mg/l	SRP mg/l	chl-a	BG Dom.	TSI-2000	Change
Big Lake	0.7	0.01	1.9	2.6	0.13	17	64	40	2
Crooked Lake	0.4	0.05	0.7	1.2	0.07	2	62	23	20
Crane Lake	0.7	0.9	1.8	3.4	0.19	25	88	51	-6
Goose Lake	1.1	0.3	2.6	4	0.21	45	98	60	-1
Green Lake	0.5	0.7	2.2	3.4	0.16	30	3	51	
Little Crooked Lake	3.1	0.01	5.3	8.4	0.5	22	27	39	7
Loon Lake	0.8	0.6	1.9	3.3	0.19	58	53	48	2
New Lake	0.6	0.02	1.2	1.8	0.15	2	83	25	18
Old Lake	0.9	0.8	2	3.7	0.35	8	94	67	19
Average	1.0	0.4	2.2	3.5	0.2			45	

Table 33. 2000 IDEM TSI Classes of the Lakes of the UTRLA Watershed

Lake	TSI Score	Class
Big Lake	40	Eutrophic
Crooked Lake	23	Mesotrophic
Crane Lake	51	Hypereutrophic
Goose Lake	60	Hypereutrophic
Green Lake	51	Hypereutrophic
Little Crooked Lake	39	Eutrophic
Loon Lake	48	Hypereutrophic
New Lake	25	Mesotrophic
Old Lake	67	Hypereutrophic
Average	45	Eutrophic

5.3 AQUATIC PLANT SURVEYS

Aquatic plant surveys are important in order to determine the abundance and distribution of species in a waterbody, to detect nuisance species, to detect excess nutrients in a waterbody, to develop habitat inventories, and to aid in the development of aquatic vegetation management plans. Surveys of the aquatic vegetation in the lakes of the UTRLA Watershed followed the Tier I Aquatic Vegetation Reconnaissance Survey Protocol (IDNR, 2006). The Tier I reconnaissance survey criteria is designed to identify the major plant beds in each lake. The survey creates an overview of the aquatic vegetation present in the lakes. A copy of the Tier I Aquatic Vegetation Reconnaissance Survey Protocol is included in Appendix E. Aquatic plant surveys were conducted on Loon, Big, New, and Old Lakes on August 1, 2007, on Goose and Crooked on August 2, 2007, and on Crane August 9, 2007. A variety of pondweeds, coontail, watermilfoil, chara, waterlily, arrowhead, cattails, and swamp loosestrife were among the dominate species present at these lakes. A list of the common and scientific names of all of the species identified and the field data sheets for each plant bed at each lake are included in Appendix E. GPS coordinates of the plant beds of each lake were recorded in the field. According to the Tier I protocol, canopy ratings are given to each plant bed based on the types of plants present. Table 34 shows the canopy rating from the Tier I protocol. Figures 44 through 47 show the location and extent of the plant beds in each lake.

Table 34. Tier I Canopy Rating

1 = <2% of canopy
2 = 2 – 20%
3 = 21 – 60%
4 = >60% of canopy

In addition to the canopy ratings, each plant bed was rated by the visual abundance of each individual species. The abundance ratings represent a percent cover measurement based on Table 35.

Table 35. Tier I Visual Abundance Rating

1 = <2% of the bed
2 = 2 – 20%
3 = 21 – 60%
4 = >60% of the bed

5.3.1 Big Lake

The plant beds of Big Lake cover approximately 32.1 acres of the lake or 14% of the lake's total surface of 228 acres. **Table 36** shows the plant species identified and the abundance rating for each species.

Table 36. Big Lake Tier I Plant Beds

	#01	#02	#03	#04	#05	#06
Plant Species						
Algae	1	1	1	1	1	1
Arrowhead	1					
Cattails	1	2	3	3		3
Chara	1			2		2
Coontail	3	3	3	3	3	
Curly Leaf Pondweed	1	1	1	1	1	2
Duckweed				1		
Eelgrass	3	3	2	2		2
Eurasian Milfoil	2		2	1	2	2
Pickerel Weed	1					
Purple Loosestrife			1			
Sago Pondweed	1			1		2
Slender Naiad	2	1		1		
Soft Stem Bulrush	1					
Spatterdock	3		3	3		3
Swamp Loosestrife			2	2		2
White Lilly	1		2	2	3	3
Total # of Species	14	6	10	13	5	10
Plant Bed Size (acres)	14.6	2.5	1.9	6.9	0.4	5.8

5.3.2 Crane Lake

The plant beds of Crane Lake cover approximately 6.9 acres of the lake or 25% of the lake's total surface of 28 acres. **Table 37** shows the plant species identified and the abundance rating for each species.

Table 37. Crane Lake Tier I Plant Beds

	#01	#02
Plant Species		
Algae	2	2
Cattails		2
Coontail	3	3
Curly Leaf Pondweed	3	
Duckweed	3	2
Eurasian Milfoil	2	3
Hard Stem Bulrush	2	
Pickerel Weed	1	
Reed Canary Grass	2	2
Sago Pondweed		2
Spatterdock	3	3
Swamp Loosestrife	3	4
Watermeal	2	2
White Lilly	3	3
Total # of Species	12	11
Plant Bed Size (acres)	4.2	2.7

5.3.3 Crooked Lake

The plant beds of Crooked Lake cover approximately 45.1 acres of the lake or 22% of the lake's total surface of 206 acres. **Table 38** shows the plant species identified and the abundance rating for each species.

Table 38. Crooked Lake Tier I Plant Beds

	#01	#02	#03	#04	#05	#06	#07	#08	#09	#10	#11	#12	#13	#14
Plant Species														
Algae	1	1	2		1	1	2	2	2	1	1	2		1
Arrowhead	2	2	2		1		3		2	3	2	3		3
Buttonbush	1													
Cattails	2	2	2				3		2	3		2		3
Chairmakers Rush	1			3	3	2	2							2
Chara	3				3	3	3	3	2	3	3	3	3	3
Coontail	2	2	2		2				2	2			2	
Crimsoneyed Rosemallow	3	2				3			1	2	2	2		2
Curly Leaf Pondweed					2									2
Eelgrass	2				2		2		2					
Eurasian Milfoil	2	2	3		3	3	3	3	3	3	2	3	3	3
Hard Stem Bulrush				3		2						2		2
Illinois Pondweed	2			2	3	3	2		3	3	2	3	3	3
Longleaf Pondweed					2									2
Pickerel Weed		2			3	2	2		3			2		
Purple Loosestrife							1		1	1	1	1		2
Ribbon Leaf Pondweed	2													
Sago Pondweed	2	2			3	3	2		2	3	2	3	3	3
Smartweed		2							3					2
Spatterdock	2	2	3		3	3	3	2	3	3	3			3
Swamp Loosestrife	3	3	2			3	3		2	3	3	3		3
White Lilly	2	2	3			3	3	2	3	3	3	3		3
Total # of Species	16	12	8	3	13	12	14	5	16	13	11	13	5	17
Plant Bed Size (acres)	6.4	3.0	1.1	2.0	1.6	5.1	6.5	0.65	3.8	4.0	2.8	2.7	0.5	4.9

5.3.4 Goose Lake

The plant beds of Goose Lake cover approximately 10.1 acres of the lake or 12% of the lake's total surface of 84 acres. **Table 39** shows the plant species identified and the abundance rating for each species.

Table 39. Goose Lake Tier I Plant Beds

	#01	#02	#03	#04
Plant Species				
Algae	2	3	1	3
Arrowhead	2	2	2	3
Cattails		2	2	3
Chara			2	
Coontail	2	3	3	3
Eelgrass			2	2
Eurasian Milfoil	1	3	3	3
Pickerel Weed		3		3
Purple Loosestrife	1		1	2
Sago Pondweed	1		3	
Spatterdock	3	3	2	2
Swamp Loosestrife	2	3		3
White Lilly	3	3	3	3
Total # of Species	9	9	11	11
Plant Bed Size (acres)	2.2	3.5	1.0	3.4

5.3.5 Loon Lake

The plant beds of Loon Lake cover approximately 41.7 acres of the lake or 19% of the lake's total surface of 222 acres. **Table 40** shows the plant species identified and the abundance rating for each species.

Table 40. Loon Lake Tier I Plant Beds

	#01	#02	#03	#04	#05	#06
Plant Species						
Algae	2	2	1	1	2	1
Arrowhead	2					
Cattails	2			1	2	
Chara		2	2	3		2
Charimakers rush					2	
Coontail	3	3	3			2
Curly Leaf Pondweed	2					
Eelgrass	3	3	3	3		2
Eurasian Milfoil	3	2	1			2
Purple loosestrife						
Spatterdock	3	3	3	3	3	
Swamp Loosestrife	2	3				
White Lilly	3	2	3	3	3	3
Total # of Species	10	8	7	6	5	6
Plant Bed Size (acres)	10.7	9.8	8.7	2.4	6.4	3.7

5.3.6 New Lake

The plant beds of New Lake cover approximately 7.1 acres of the lake or 14% of the lake's total surface of 50 acres. Table 41 shows the plant species identified and the abundance rating for each species.

Table 41. New Lake Tier I Plant Beds

	#01	#02	#03
Plant Species			
Algae	1		2
Arrowhead	2		
Cattails	1	2	2
Chara	3	2	2
Eurasian Milfoil	2	1	
Illinois Pondweed		3	3
Large leaf Pondweed	1		
Longleaf Pondweed	2		
Pickerel Weed	1	1	2
Smartweed	3		3
Soft Stem Bulrush	3	3	3
Spatterdock	3	2	
Swamp Loosestrife	2	3	
White Lilly	3	4	3
Total # of Species	13	9	8
Plant Bed Size (acres)	4.8	1.4	0.9

5.3.7 Old Lake

The plant beds of Old Lake cover approximately 6.1 acres of the lake or 19% of the lake's total surface of 32 acres. Table 42 shows the plant species identified and the abundance rating for each species.

Table 42. Old Lake Tier I Plant Beds

	#01	#02	#03
Plant Species			
Algae	1	1	1
Arrowhead		2	
Cattails	4	3	3
Coontail	3	3	3
Curly Leaf Pondweed	2		
Duckweed			1
Eurasian Milfoil	2		2
Pickerel Weed		2	2
Sago Pondweed	2	2	2
Spatterdock	3	3	3
Swamp Loosestrife	3	3	3
White Lilly	3	3	
Total # of Species	9	9	9
Plant Bed Size (acres)	1.2	1.8	3.1

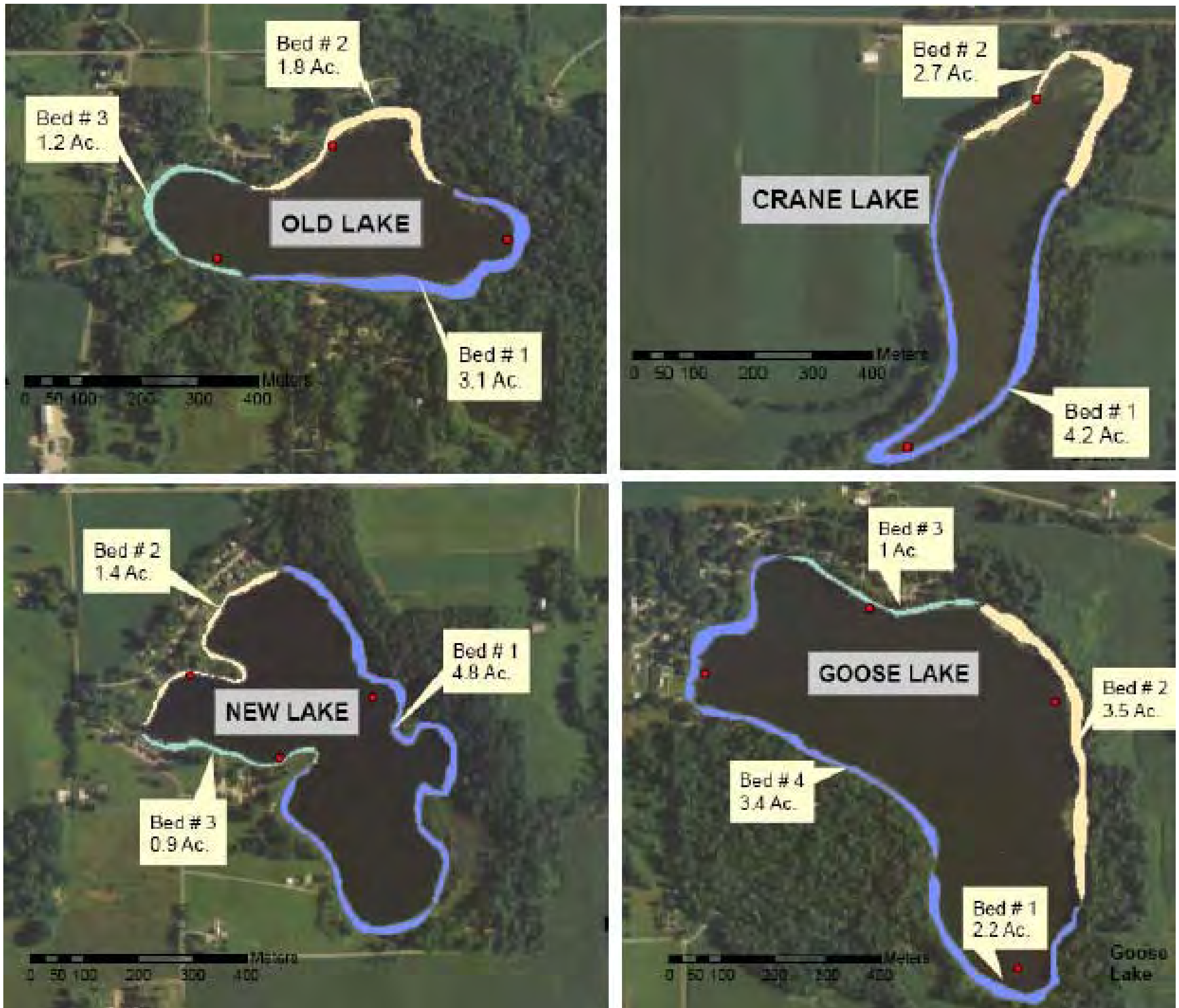

Figure 44. Aquatic Plant Beds in Old, Crane, New, and Goose Lakes

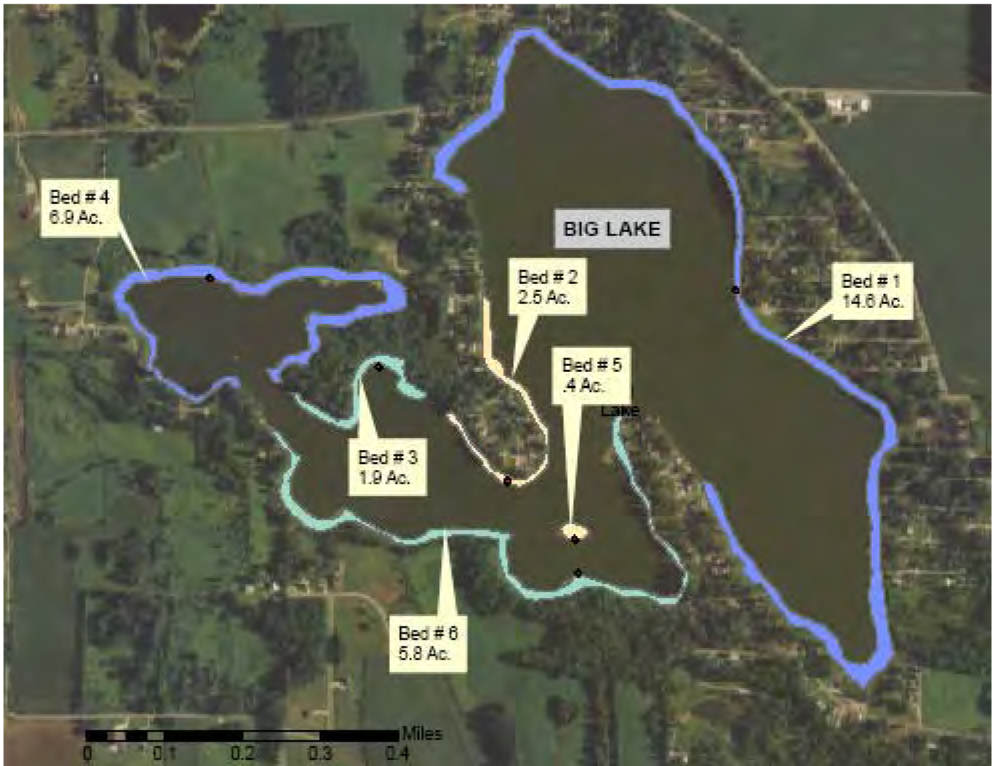

Figure 45. Aquatic Plant Beds in Big Lake

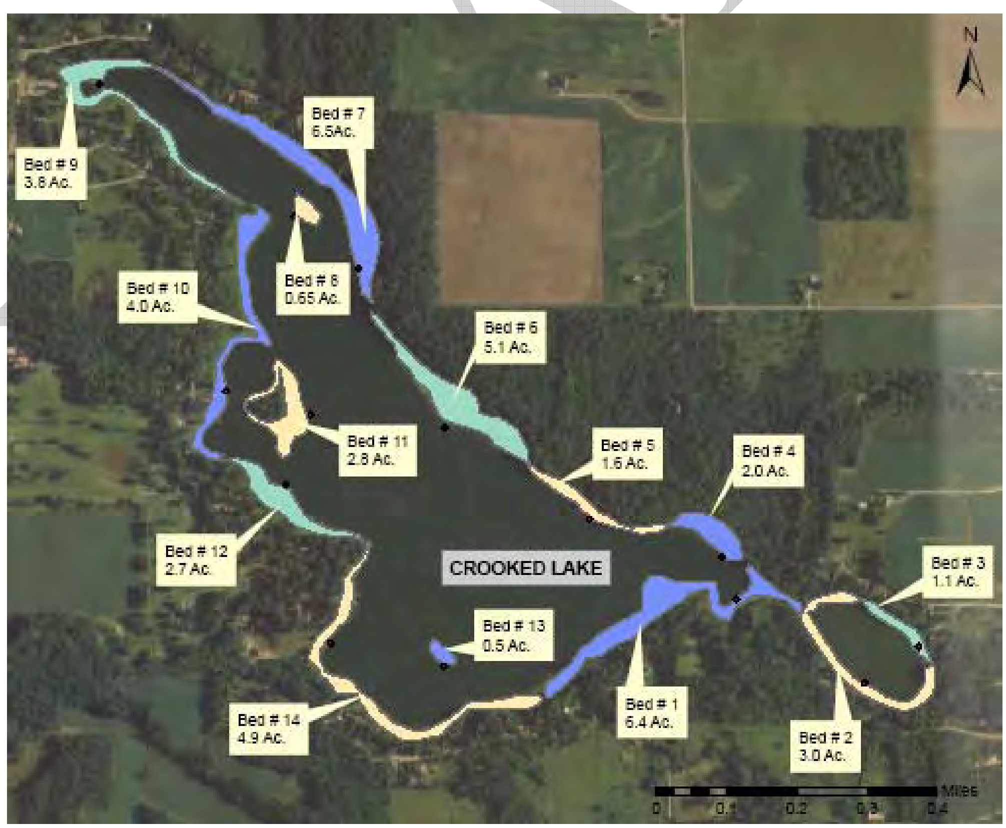

Figure 46. Aquatic Plant Beds in Crooked Lake

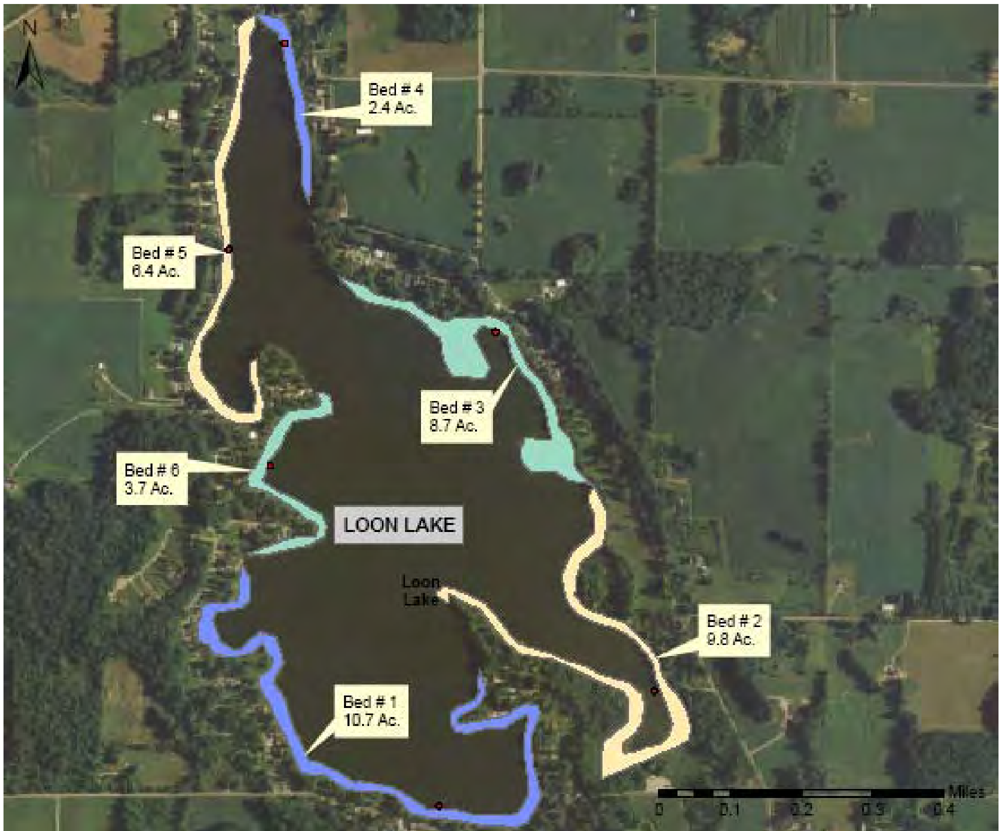

Figure 47. Aquatic Plant Beds in Loon Lake

5.4 WATERSHED SURVEY

A watershed survey of the UTRLA Watershed was conducted in order to locate potential sources of water quality degradation and to obtain an understanding of general trends within the watershed. On January 8 and 9, 2007, WCC conducted a watershed survey of the entire UTRLA Watershed. Lakeshore assessments were conducted during the aquatic plant surveys on August 1, 2, and 9, 2007. Supplemental inventories were conducted before some steering committee meetings as more information concerning the watershed was gathered throughout the planning process. In addition to the watershed survey, the members of the steering committee provided their local knowledge of other significant areas within the UTRLA Watershed at the April and May steering committee meetings. Aerial photographs were also reviewed to gain information during this watershed assessment.

Observations included:

- areas needing buffer strips
- tillage trends
- areas needing grassed waterways
- potential conservation easement areas
- potential wetland restoration areas
- areas needing sediment traps or bioretention filters
- areas needing rotational grazing
- areas needing nutrient management

- livestock with access to the stream
- animal feeding operations (AFOs, CFOs, and CAFOs)
- significant natural or recreational areas
- potentially unsewered communities
- areas needing streambank or lakeshore stabilization or grade control
- lakeshore development
- shoreline composition

Subwatershed A

A potential area for wetland restoration is located in northern portion of this watershed, and an area needing a grassed waterway is located in the southern portion. The Old Lake public access is also located in this subwatershed on its far east side. The locations of the recommended BMPs in Subwatershed A are shown in Figure 48. Over one third of the tributaries in Subwatershed A have inadequate buffers, approximately one third have forested buffers, and a quarter have grassed buffers. One potentially unsewered community is located in the central portion of the subwatershed less than a quarter mile from the Old Lake South Inlet.

Subwatershed B

Two potential areas for wetland restoration are located within this watershed, one in the northern portion and one in the southern portion. An area needing a sediment trap is located along the Old Lake north inlet in the central portion of the subwatershed. The locations of the recommended BMPs in Subwatershed B are shown in Figure 48. Almost two thirds of the tributaries in Subwatershed B have inadequate buffers, while approximately a quarter have grassed buffers, and the remainder of the tributaries is bordered by residential lawns.

Subwatershed C

An area needing buffers and an area needing a bioretention filter are located on the Loon Lake west inlet 1 in the northern portion of the subwatershed. An area needing a sediment trap is located along the Loon Lake west inlet 2 in the northern portion of the subwatershed, and an area needing rotational grazing is also located in the northern portion. The southern portion of the subwatershed contains a potential area for a conservation easement. Figure 49 shows the locations of the recommended BMPs for Subwatershed C. Shortly after the watershed survey, it was learned that USDA funding had been received for the rotational grazing and the sediment trap mentioned above, and have since been implemented. Observations of the pasture after the rotational grazing had been implemented showed a tremendous increase in vegetative cover. The sediment trap was finished at approximately the same time as the close of this report; therefore, conclusions about its effectiveness could not be drawn. Over half of the tributaries in Subwatershed C have forested buffers, while less than a quarter have inadequate buffers, and approximately a quarter are bordered by residential lawns.

Subwatershed D

Subwatershed D contains a potential area for a conservation easement in the northeastern portion and an area needing a grassed waterway in the western portion. The locations of the recommended BMPs in Subwatershed D are shown in Figure 49. Of the tributaries located in Subwatershed D, 44% have forested buffers, 22% have grassed buffers, 10% have inadequate buffers, and 24% are bordered by residential lawns.

Subwatershed E

Seven areas needing buffer strips are located within this subwatershed, four are along Winter's Ditch, two are along the Goose Lake inlet, and one is located along the southwestern shore of Goose Lake. Figure 49 shows the locations of the recommended BMPs for Subwatershed E. Over half of the tributaries in Subwatershed E have forested buffers, while approximately a third have inadequate buffers, and most of the remainder has grassed buffers. Both the Goose and Loon Lakes' public accesses are located in this subwatershed, as well as the Goose Lake Fish and Wildlife Area.

Subwatershed F

Subwatershed F contains three areas along Friskney Ditch needing buffers. An area needing a sediment trap is located near where Friskney Ditch inlets to Loon Lake. Figure 50 shows the locations of the recommended BMPs for Subwatershed F. The majority of the tributaries in Subwatershed F have inadequate buffers (81%), while most of the remaining tributaries are forested (14%), and a small amount have grassed buffers (4%).

Subwatershed G

Two areas needing buffers are located along the Tippecanoe River in this subwatershed. The locations of the recommended BMPs in Subwatershed G are shown in Figure 51. In Subwatershed G, the majority of the tributaries have inadequate buffers (82%), while 14% are forested, and the rest are bordered by residential lawns.

Subwatershed H

Subwatershed H contains four areas needing buffers, three along Haroff Branch and one along Stuckman Ditch. An area needing nutrient management is located adjacent to Haroff Branch in the northern portion of this subwatershed, and a grassed waterway is needed adjacent to Stuckman Ditch just north of Big Lake. The locations of the recommended BMPs in Subwatershed H are shown in Figure 51. Almost two thirds of the tributaries in Subwatershed H have inadequate buffers, while almost one third is forested. A dairy farm is located in this subwatershed, which is estimated to have 100 head.

Subwatershed I

A sediment trap located where Sell Ditch inlets to Big Lake would help reduce the sediment and nutrients being loaded in Big Lake by this ditch. Five areas needing buffers are located in this subwatershed, four along Sell Ditch and one along a tributary to Sell Ditch in the southern portion. A grassed waterway is needed adjacent to the central reaches of Sell Ditch. Figure 51 shows the locations of the recommended BMPs for Subwatershed I. Approximately two thirds of the tributaries in Subwatershed I have inadequate buffers, while less than a quarter have forested buffers, 10% are bordered by residential lawns, and the small remainder has grassed buffers (4%). Three potentially unsewered communities are located in the southern portion of the subwatershed, all within a quarter mile from the upstream reaches of Sell Ditch. The Big Lake public access is located in this subwatershed.

Subwatershed J

Two areas needing grade stabilization are located in this subwatershed, one north and east and one south and west of Crooked Lake. A bioretention filter located along the Crooked Lake south inlet would help trap nutrients and sediment before they enter Crooked Lake. A sediment trap located just east of Little Crooked Lake would help reduce the sediment and nutrients being loaded into this lake. The shore of the island located on the western side of Crooked Lake is eroding and the banks need to be stabilized. Figure 52 shows the locations of the recommended BMPs for Subwatershed J. The majority of the tributaries in this subwatershed have forested buffers (70%), while 27% are bordered by residential lawns, and the remaining 3% have inadequate buffers. This subwatershed contains four significant natural and recreational areas, the Crooked Lake Nature Preserve, the Crooked Lake Golf Course, the IPFW Crooked Lake Biological Station, and the Crooked Lake public access.

Subwatershed K

The majority of the tributaries located in Subwatershed K have forested buffers (91%), while the remaining 9% are bordered by residential lawns. No BMPs appear necessary for this subwatershed at this time.

Subwatershed L

Subwatershed L contains two areas needing buffers, one along the Crane Lake inlet and one along the northwestern shore of Crane Lake. A grassed waterway is needed in the northeastern portion of the subwatershed. The locations of the recommended BMPs in Subwatershed L are shown in **Figure 52**. Just over half of the tributaries in this subwatershed have forested buffers, while over one third have inadequate buffers, and the small remainder are bordered by residential lawns. The Crane Lake public access is located in this subwatershed.

Subwatershed M

Two areas needing buffers are located along the Crane Lake inlet, and two grassed waterways, both adjacent to the Crane Lake inlet are needed in this subwatershed. The locations of the recommended BMPs in Subwatershed M are shown in **Figure 52**. All of the tributaries in Subwatershed M have inadequate buffers.

Big Lake Shoreline

The majority of the Big Lake shore is developed with single family residences and one grocery store/gas station, while the remainder is undeveloped. Eight small areas of the Big Lake shoreline are composed of rock. Two small areas are composed of concrete shoreline, while the majority of the shoreline remains in a natural state. The Big Lake shore development and shoreline composition are depicted in **Figure 53**.

Crane Lake Shoreline

Both the lakeshore development and the shoreline composition of Crane Lake remain entirely in a natural state. Crane Lake is the only lake uninhabited by humans in the UTRLA Watershed. The Crane Lake shore development and shoreline composition are depicted in **Figure 54**.

Crooked Lake Shoreline

The majority of the Crooked and Little Crooked Lake shore is developed with single family homes. A long stretch of the northeast shore is, however, undeveloped. The majority of the shoreline composition is natural, while less than a quarter of the shoreline is composed of rock, timber, and concrete for bank stabilization. The Crooked Lake shore development and shoreline composition are depicted in **Figure 55**.

Goose Lake Shoreline

Approximately one quarter of the Goose Lake shore is developed with single family residences and one resort, while the remaining three quarters are undeveloped. The vast majority of the shoreline has been left to its natural state, with only three small areas composed of rock. A channel extending from the northwest side of the lake is composed of concrete. The Goose Lake shore development and shoreline composition are depicted in **Figure 56**.

Loon Lake Shoreline

Most of the Loon Lake shore has been developed with single family residences, while the southeast shoreline remains undeveloped. Over half of the shoreline has been left in its natural state, while the remainder is composed largely of rock with one small area composed of timber. The Loon Lake shore development and shoreline composition are depicted in Figure 57.

New Lake Shoreline

The majority of the New Lake shore has remained undeveloped. However, the northwest shore and three areas along the southwest shore have been developed with single family residences. Most of the shoreline has been left in its natural state, while two small areas are composed of rock. The New Lake shore development and shoreline composition are depicted in Figure 58.

Old Lake Shoreline

Approximately half of the Old Lake shore has been developed, while the other half remains undeveloped. The entire shoreline has been left in its natural state. The Old Lake shore development and shoreline composition are depicted in Figure 59.

All areas bordering the streams or ditches of the UTRLA Watershed were categorized as forested buffers, grassed buffers, inadequate buffers, or residential lawns (Figures 60 and 61). Buffers were only categorized as forested or grassed if they extended 30 feet from either side of the tributary. Sewer systems have been installed at all of the lakes in the UTRLA Watershed, however, residences in the remainder of the watershed outside of these sewer districts are presumed to be on septic systems. As stated by a Hoosier Environmental Council publication, "EPA has stated that a density of greater than 40 septic systems per square mile is a potential water quality problem." Therefore, clusters of houses in the UTRLA Watershed with this density or greater located outside of the known sewer districts were identified during the watershed survey as a potential threat to water quality. Figure 62 shows the approximate locations of these potentially unsewered communities. Small numbers of livestock were observed at farms in some of the subwatersheds. However, only those animals that could be seen from the road could be counted, providing unreliable numbers. Therefore the locations of these farms were not identified in this study.

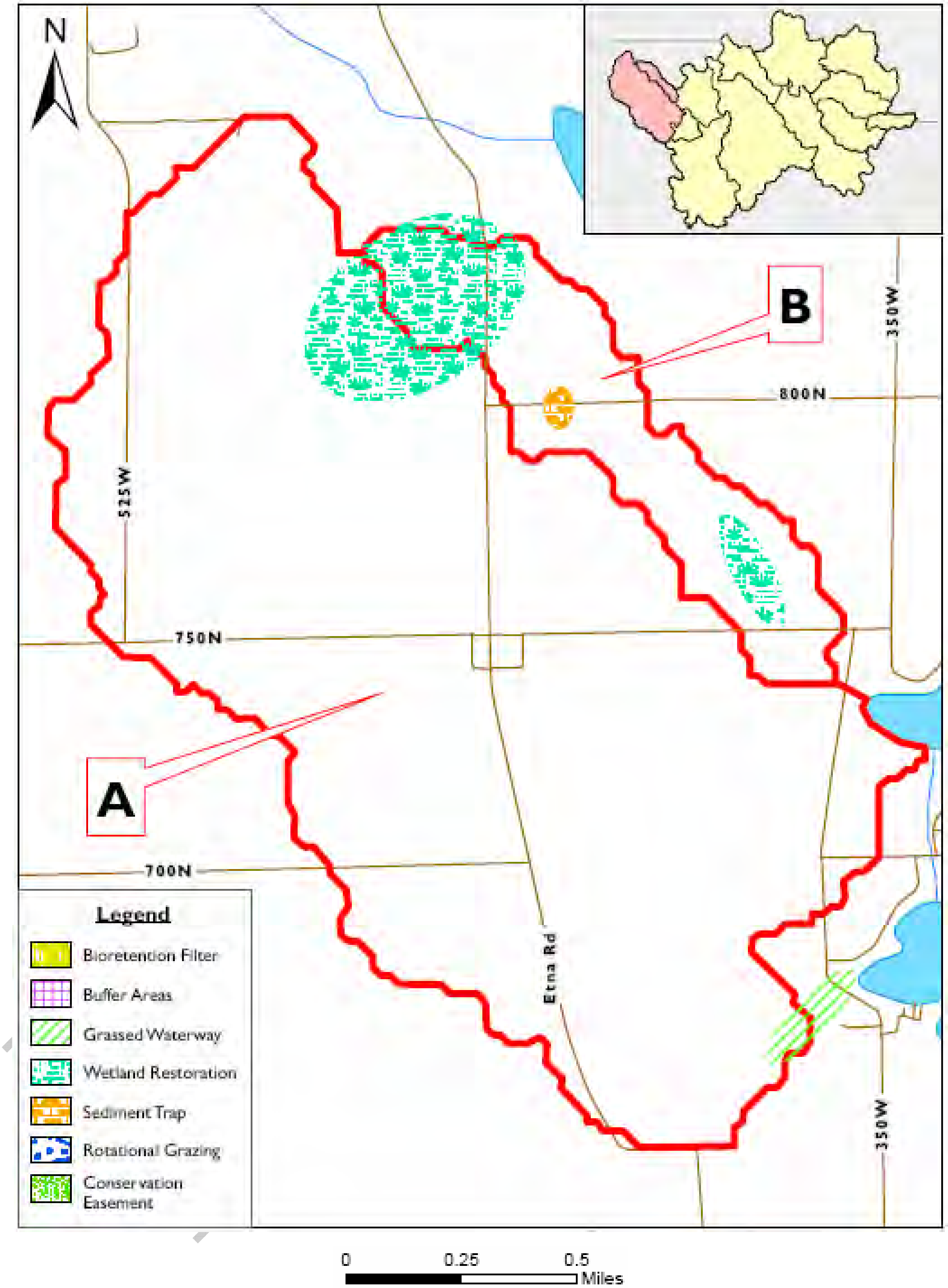

Figure 48. Recommended BMPs for Subwatersheds A and B

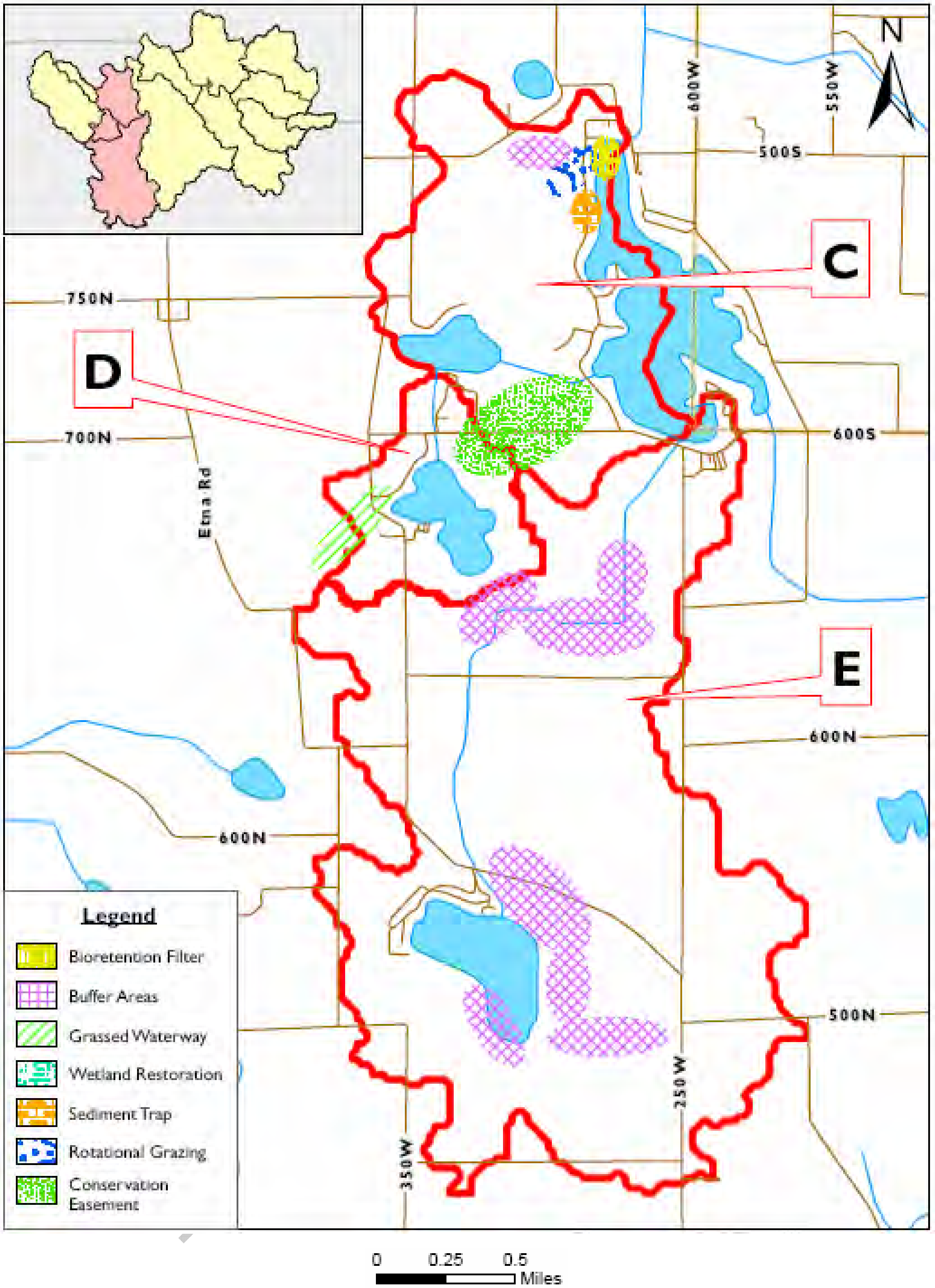

Figure 49. Recommended BMPs for Subwatersheds C, D, and E

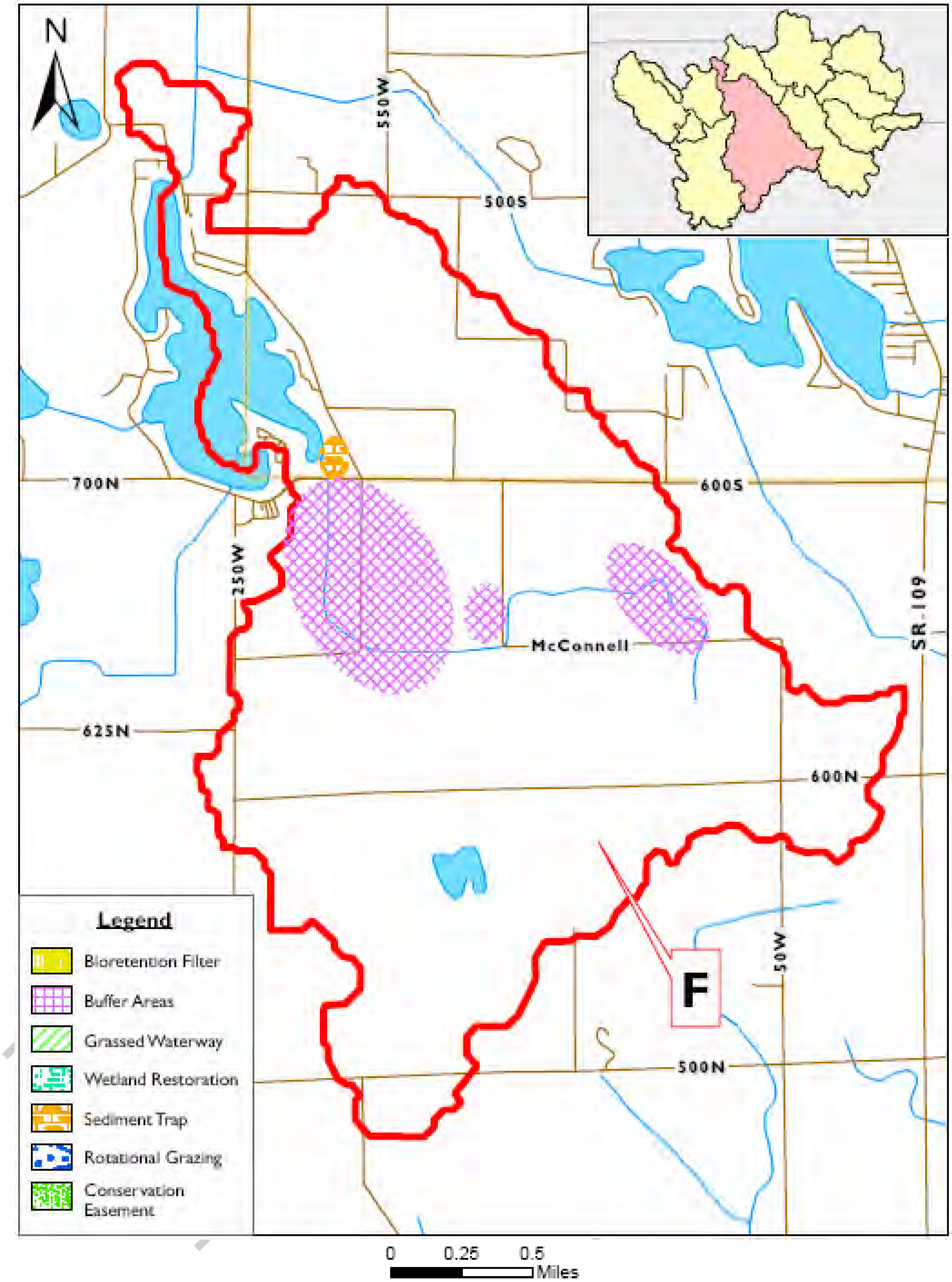

Figure 50. Recommended BMPs for Subwatershed F

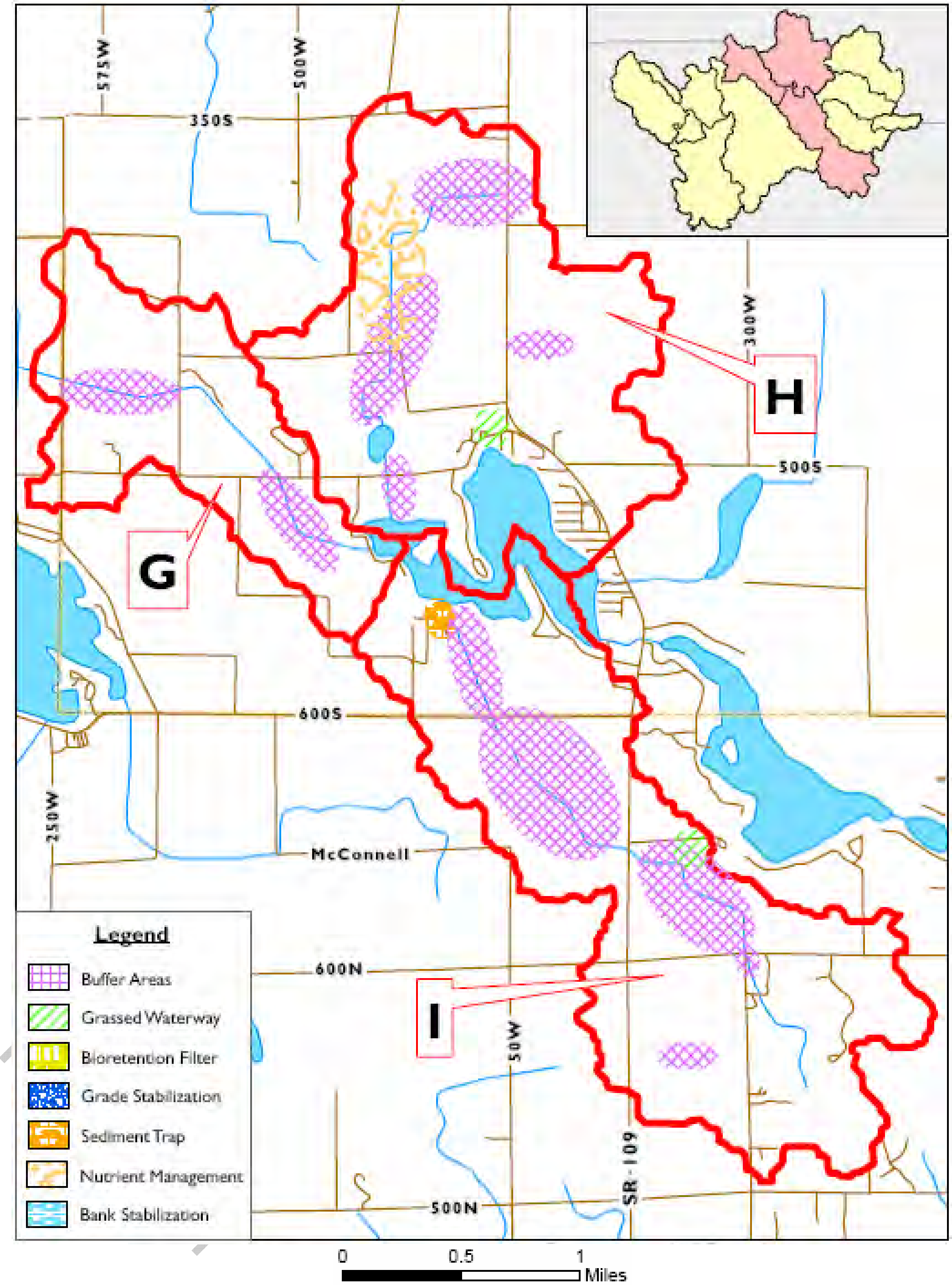

Figure 51. Recommended BMPs for Subwatersheds G, H, and I

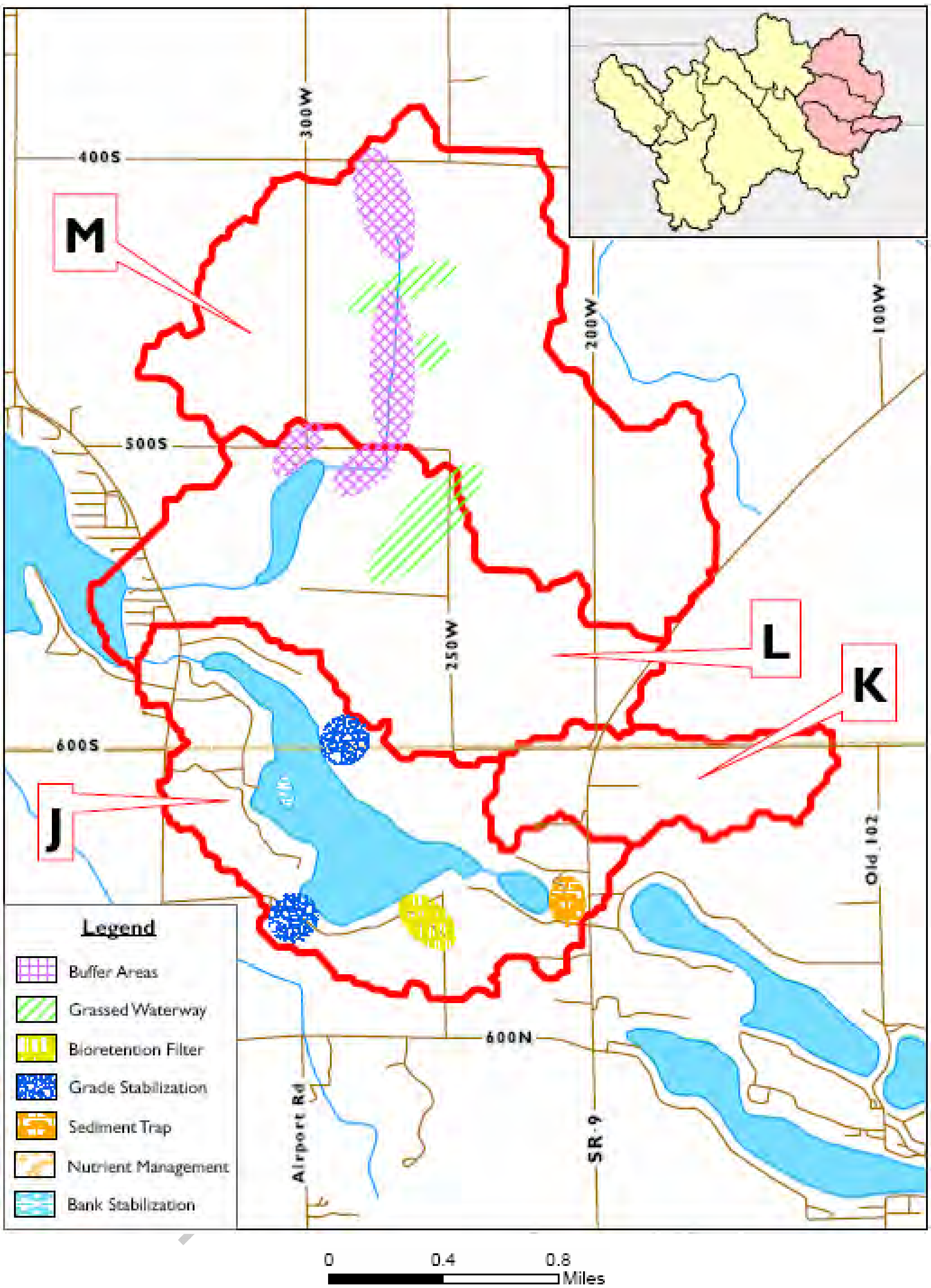

Figure 52. Recommended BMPs for Subwatersheds J, K, L, and M

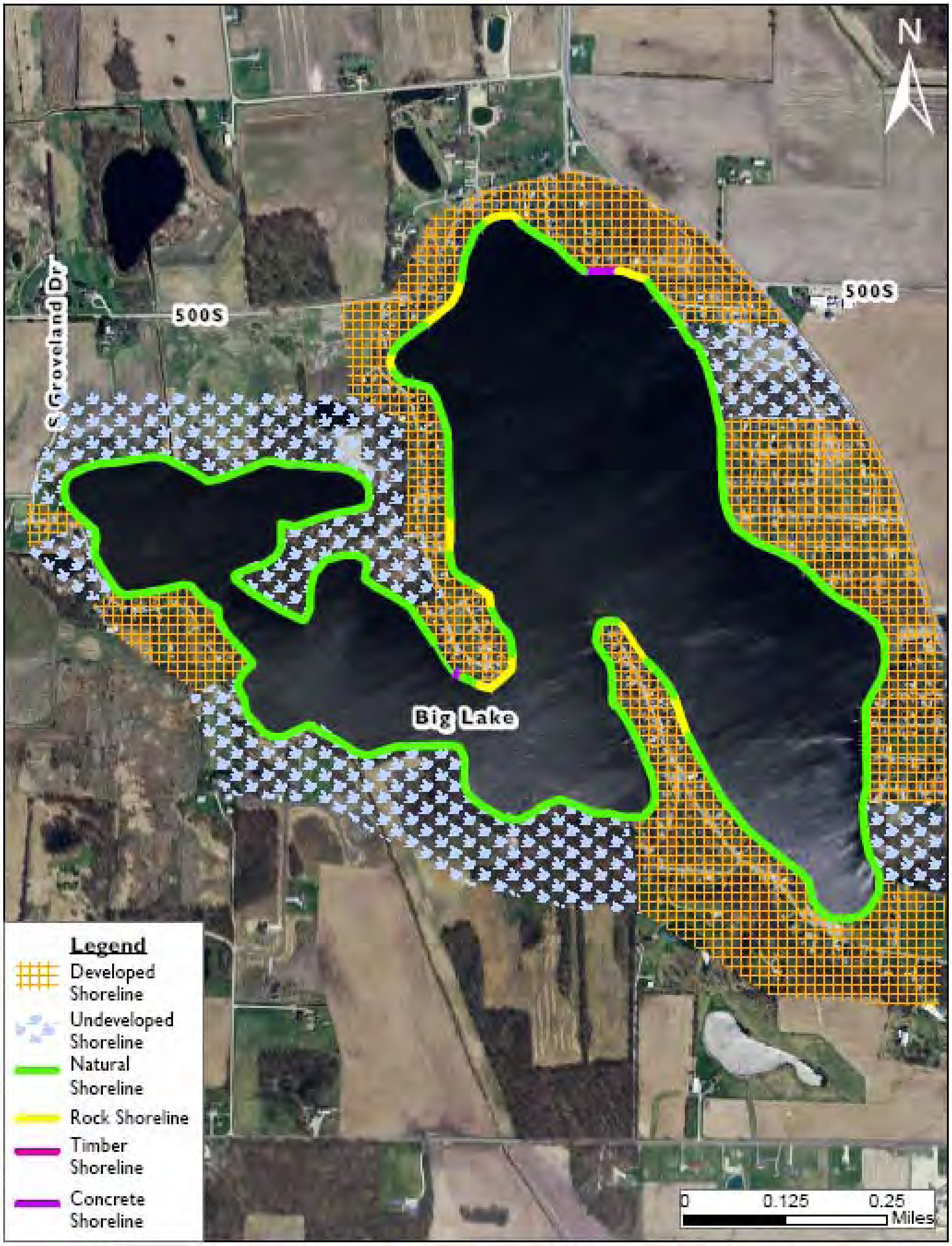

Figure 53. Big Lake Shore Development and Shoreline Composition

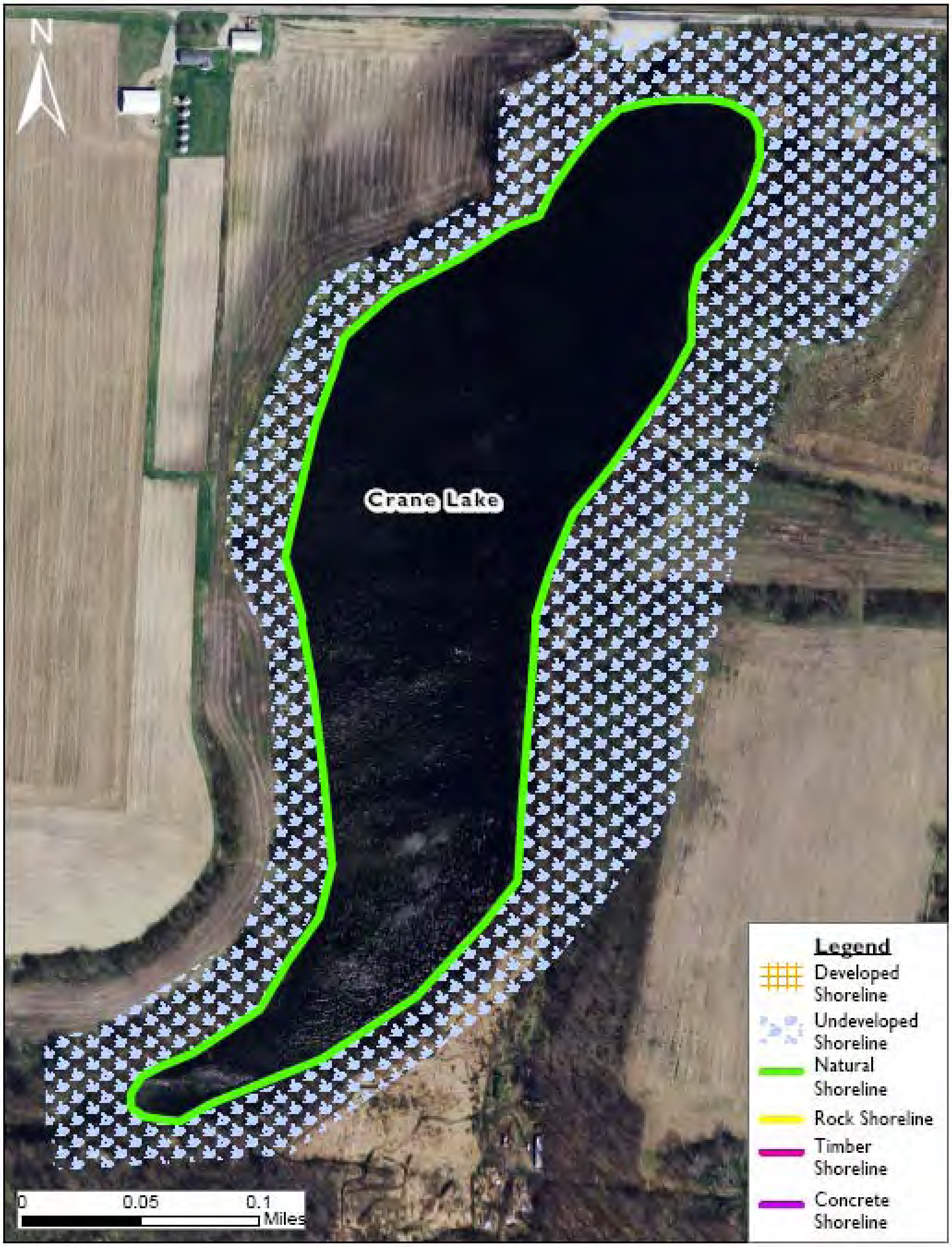

Figure 54. Crane Lake Shore Development and Shoreline Composition

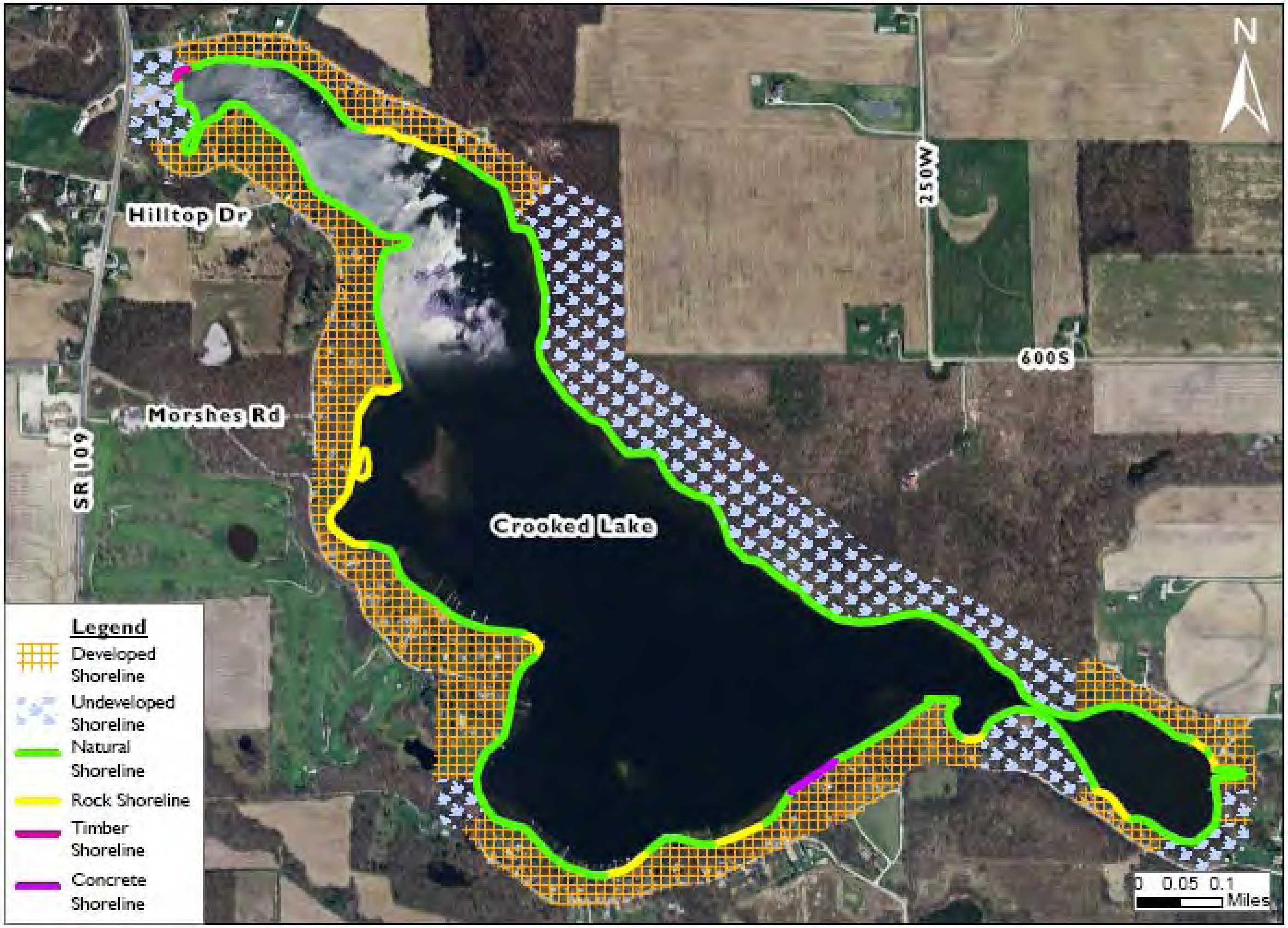

Figure 55. Crooked Lake Shore Development and Shoreline Composition

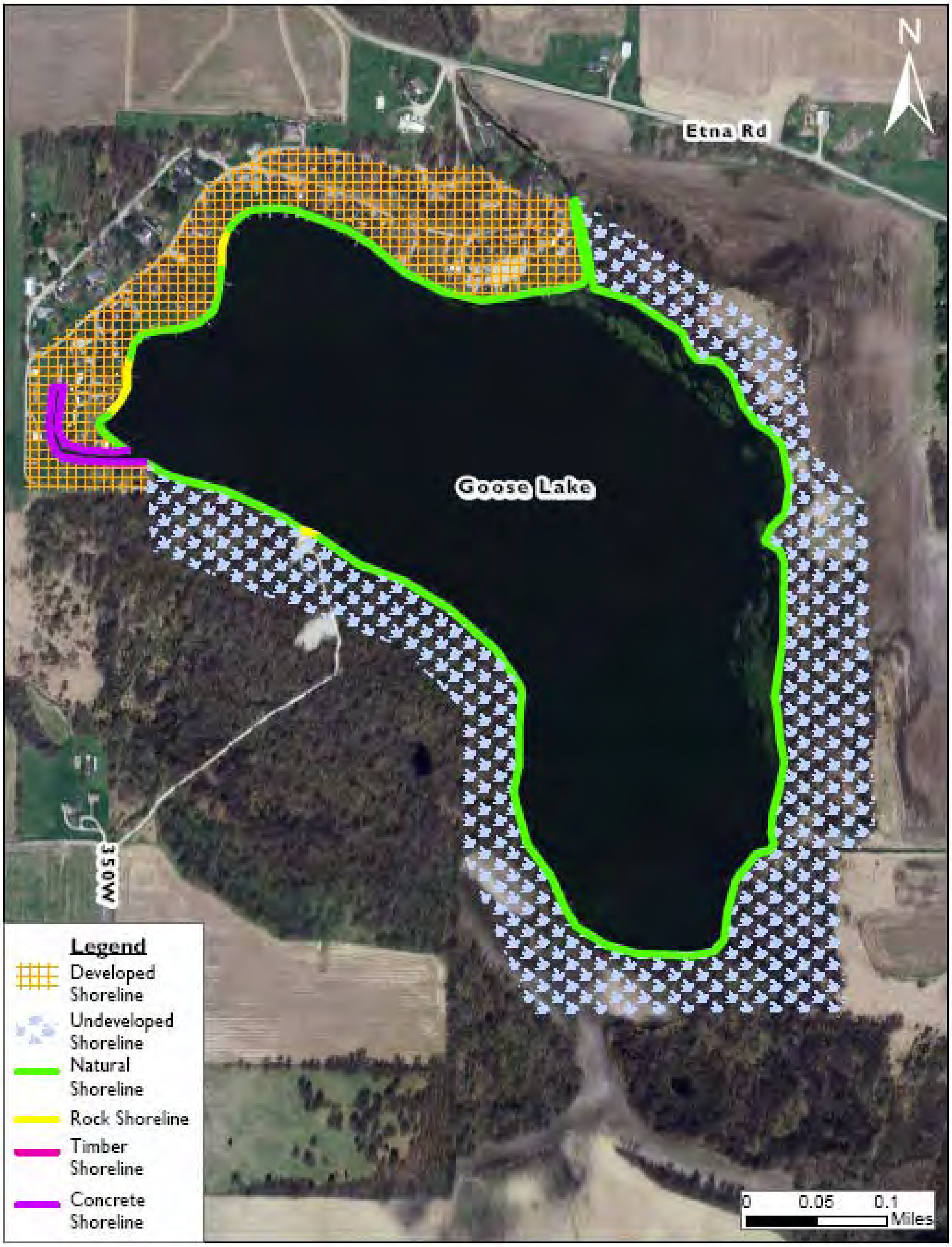

Figure 56. Goose Lake Shore Development and Shoreline Composition

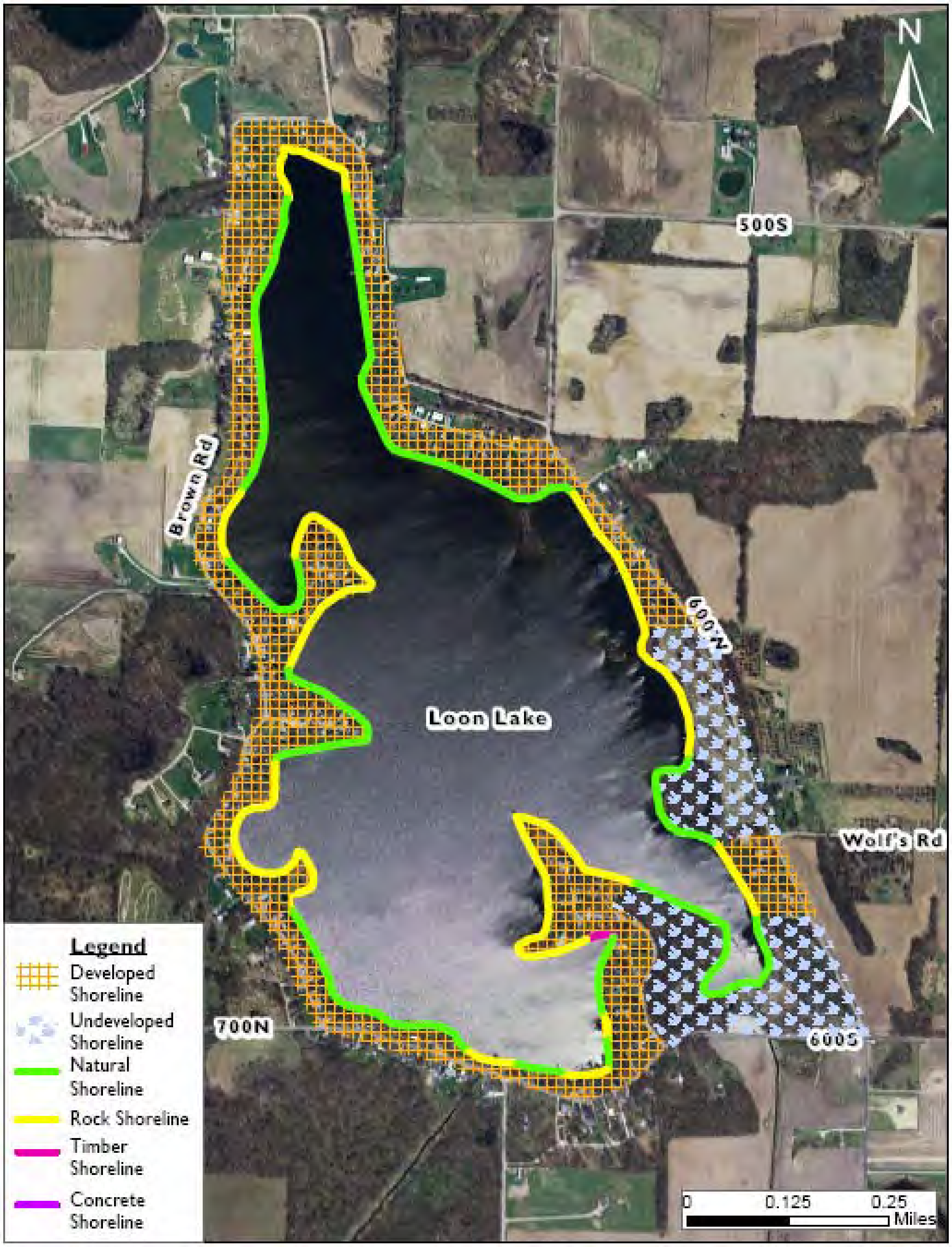

Figure 57. Loon Lake Shore Development and Shoreline Composition

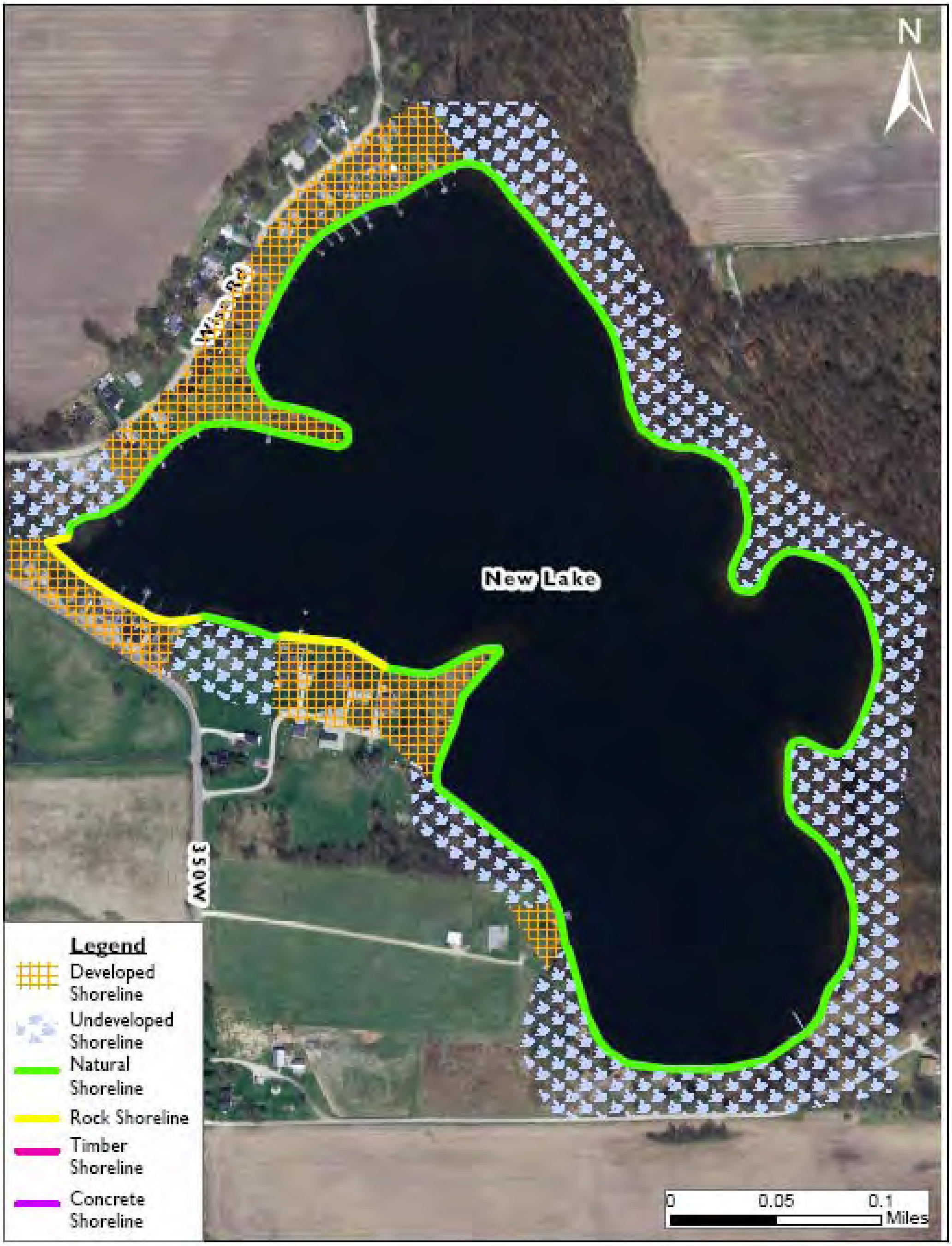

Figure 58. New Lake Shore Development and Shoreline Composition

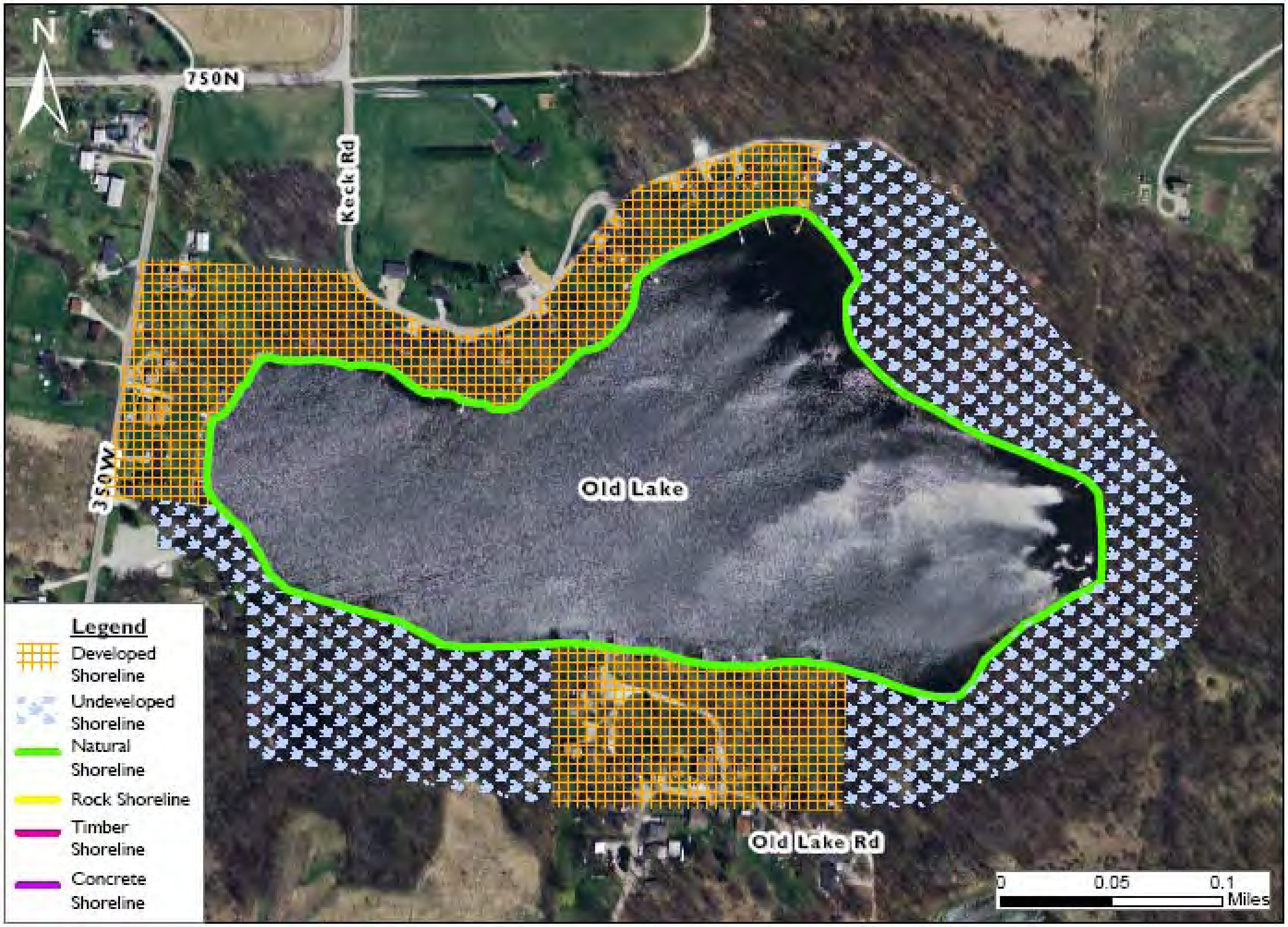

Figure 59. Old Lake Shore Development and Shoreline Composition

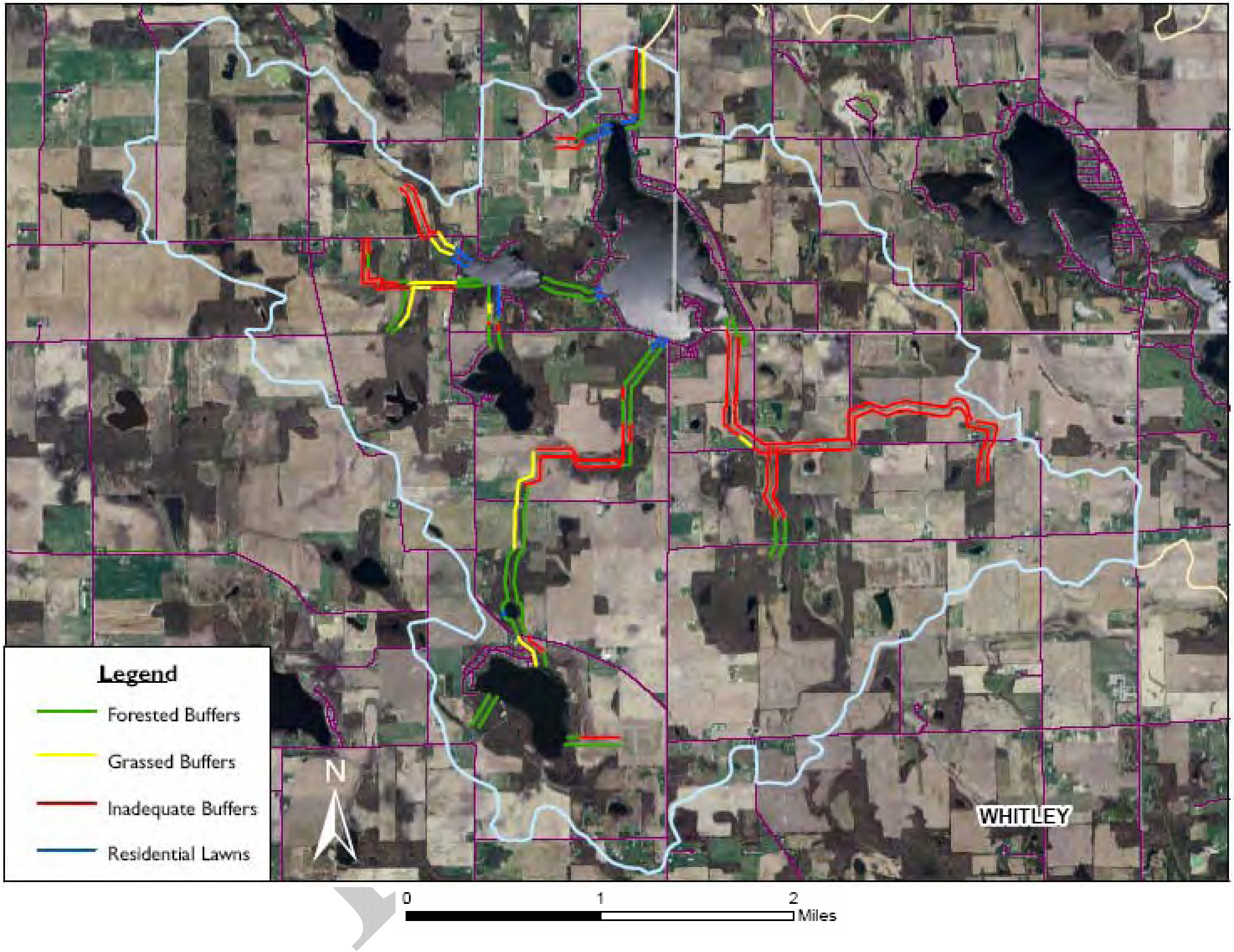

Figure 60. Riparian Areas with Inadequate Buffers, Grassed Buffers, Forested Buffers, or Residential Lawns

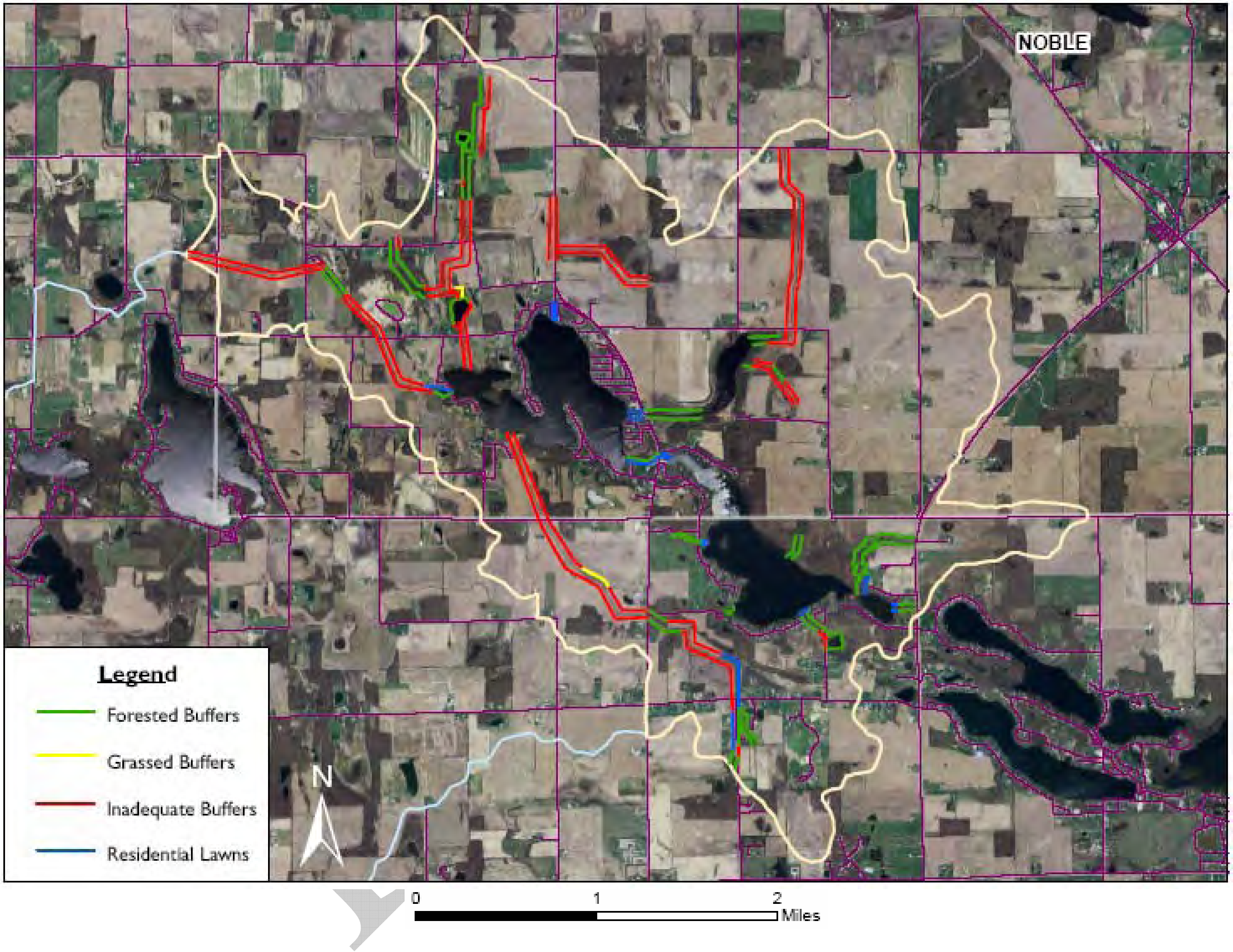

Figure 61. Riparian Areas with Inadequate Buffers, Grassed Buffers, Forested Buffers, or Residential Lawns

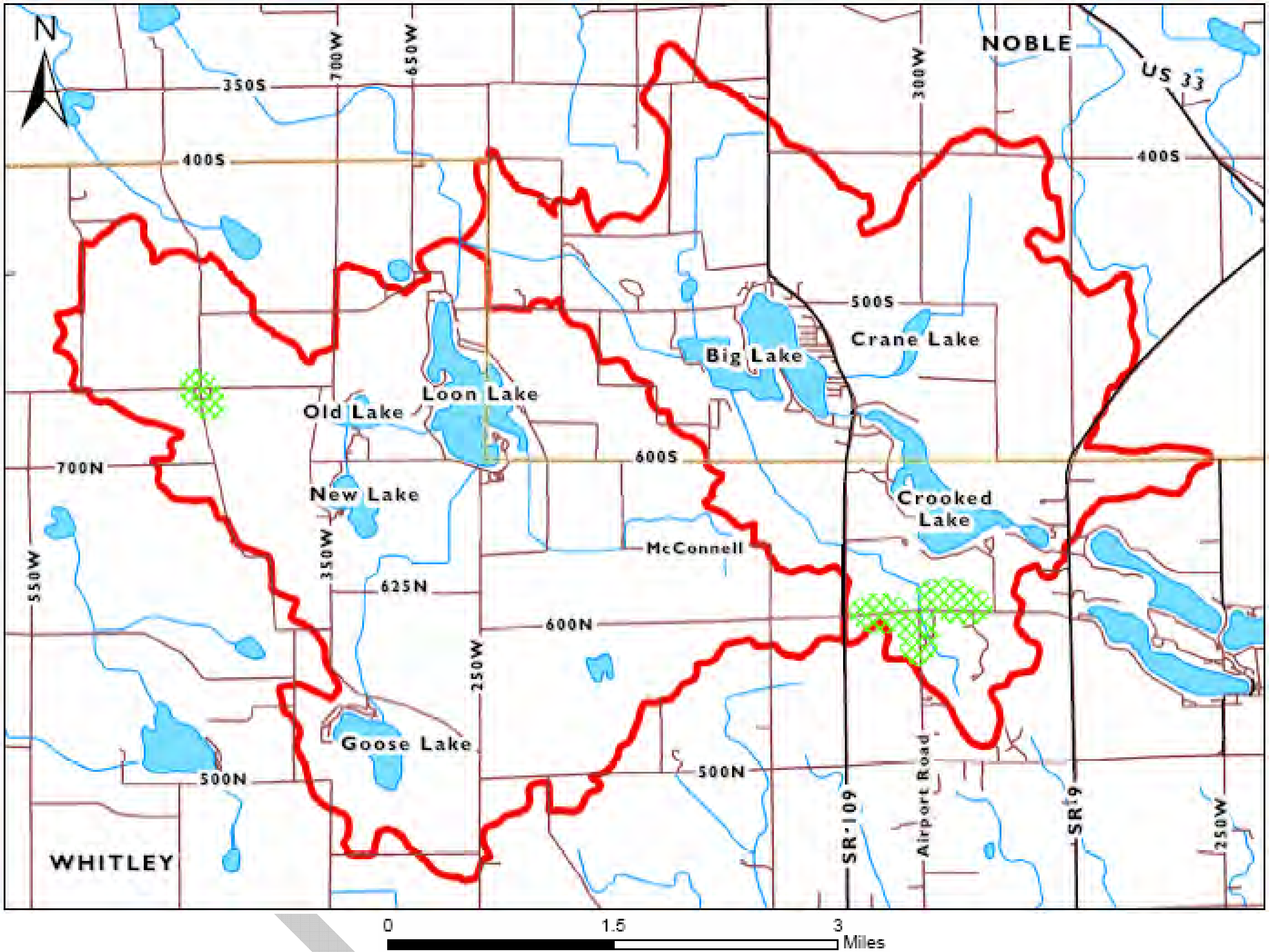

Figure 62. Potentially Unsewered Communities in the UTRLA Watershed

5.5 POLLUTANT LOAD MODELING

In order to help identify potential areas of concern within the watershed, The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was applied using available soil and rainfall data. IDEM recommended several computer modeling programs, which included STEPL (http://it.tetratech-ffx.com/stepl/default.htm). STEPL is a computer modeling program developed by the US Environmental Protection Agency. STEPL employs simple algorithms to calculate nutrient and TSS loads from different land uses and the load reductions that would result from the implementation of various BMPs. Using county rainfall and soil data, it computes watershed surface runoff and nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

5.5.1 STEPL Input

STEPL uses watershed size, land use, agricultural animal data, onsite wastewater data, universal soil loss equation parameters, national weather service rainfall data, and soil type to generate pollutant loading rates. Input parameters used for this watershed plan are included in STEPL data in Appendix F. Sources for these inputs are described below.

<u>Subwatershed Areas</u>

The STEPL program gave each subwatershed a new designation (W1-13). The 13 subwatersheds and their new designations are listed in Table 43.

Table 43. Subwatersheds - STEPL Number, ID Letter, Name, Acreage

STEPL #	Subwatershed	Watershed Name	Area (Acres)
W1	A	Old Lake South Inlet	1289
W2	B	Old Lake North Inlet	257
W3	C	West Side Loon Lake	869
W4	D	New Lake	297
W5	E	Goose Lake/ Loon Lake Winters Ditch	1947
W6	F	Loon Lake Friskney Ditch	2600
W7	G	Tippecanoe River	841
W8	H	Green Lake/Stuckman Ditch	1367
W9	I	Big Lake Sell Ditch	1306
W10	J	Crooked Lake	740
W11	K	Crooked Lake Farm Ditch	214
W12	L	Big Lake Crane Lake Inlet	735
W13	M	Crane Lake North Inlet	1086

Land Use
There are six types of primary land use in STEPL – Urban, Cropland, Pastureland, Forest, User Defined, and Feedlots. Areas for each land use were derived using HYMAPS-OWL (2005, Purdue Research Foundation). The HYMAPS-OWL (http://cobweb.ecn.purdue.edu/~watergen/) is a web based interactive GIS database that allows the user to delineate watershed characteristics by HUC. These areas can be found earlier in the report in Table 9.

Agricultural Animal Use
Animal use data was derived using National Agricultural Statistics Service and the Indiana Agricultural Statistics databases, the windshield survey, and local landowner interviews were used to estimate the type and number of agricultural animals by subwatershed. Animal types included beef cattle, dairy cattle, swine, sheep, and horses.

Wastewater Data
Onsite septic system data was based on homes noted on aerial maps, but outside of known sewer service districts.

Universal Soil Loss Equation (USLE)
USLE parameters were automatically generated by STEPL based on county.

Best Management Practices
BMP amounts can be input into STEPL and using the known BMP efficiencies the program generates pollutant loads based on the BMP amounts input. BMP amounts for the UTRLA Watershed were compiled from aerial photographs, the windshield survey information, tillage transect information, and observations from landowners within the watershed. The existing BMPs currently in place in the UTRLA Watershed were input into STEPL to calculate the existing pollutant loads. The existing BMPs in the UTRLA Watershed are reduced tillage and filter strips. Among the land in row crops in the watershed, 77 percent is considered to practice "Reduced Tillage". The estimated acreage of reduced tillage within the watershed is 6,670 acres. "Filter Strips" were included as best management practices based on actual occurrences, an estimated 45 percent of the streams in the watershed were adequately buffered.

5.5.2 STEPL Results

STEPL generated annual mass loads for existing conditions in the UTRLA Watershed by subwatershed for nitrogen, phosphorus, and TSS based on the inputs described above. These parameters are briefly described below:

- *Nitrogen* is an essential plant nutrient found in fertilizers, human and animal wastes, yard waste, and the air. About 80% of air is nitrogen gas. This nitrogen can diffuse into water where it can be "fixed", or converted, by blue-green algae for their use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia through runoff from numerous sources. Because of this, there is an abundant supply of available nitrogen to aquatic systems.

- *Phosphorus* is an essential plant nutrient, and the one that most often controls aquatic plant (algae and macrophyte) growth. It is found in fertilizers, human and animal wastes, and yard waste. There are few natural sources of phosphorus to streams other than that which is attached to soil particles, and there is no atmospheric (vapor) form of phosphorus.

- *Total Suspended Solids (TSS)* measurement quantifies all particles suspended in stream water. Closely related to turbidity, this parameter quantifies sediment particles and other solid compounds typically found in stream water. In general, the concentration of suspended solids is greater during high flow events due to increased overland flow. The increased overland flow erodes and carries more soil and other particulates to the stream.

Table 44 shows the current Nitrogen, Phosphorus, and TSS loads, as modeled by the STEPL program, in the subwatersheds of the UTRLA Watershed. These modeled loads are generated with the existing conditions of the watershed, including the BMPs currently in place. Table 45 shows the Nitrogen, Phosphorus, and TSS loads generated by various land uses in the UTRLA Watershed as modeled by STEPL under existing conditions in the watershed. As shown in this table, the largest Nitrogen, Phosphorus, and TSS loads are produced by the cropland land use. Following cropland, the pastureland and urban land uses produced the next largest loads. Figures 63-65 compares the subwatersheds by their Nitrogen, Phosphorus, and TSS loads modeled by STEPL under existing conditions.

Table 44. STEPL Results - Nitrogen, Phosphorus, and TSS Loads with Existing Best Management Practices

STEPL #	Subwatershed	N Load lb/year	P Load lb/year	TSS Load t/year
W1	A	969.6	213.8	68.9
W2	B	219.6	44.0	14.3
W3	C	1498.1	208.4	37.3
W4	D	534.6	58.5	14.4
W5	E	2921.3	422.1	111.9
W6	F	2091.7	446.6	151.2
W7	G	645.3	116.0	26.3
W8	H	1469.7	292.7	82.8
W9	I	1294.8	270.8	83.0
W10	J	1040.9	178.3	30.1
W11	K	223.4	46.2	14.3
W12	L	665.9	139.3	44.9
W13	M	793.0	177.9	70.6
Total		14368.0	2614.6	749.9

Table 45. STEPL Results - Total Load by Land Use per Year with Existing BMPs

Sources	N Load (lb/yr)	P Load (lb/yr)	Sediment Load (t/yr)
Urban	5768.12	887.68	132.44
Cropland	5173.24	1240.17	572.32
Pastureland	907.30	79.66	22.52
Forest	369.91	176.64	22.61
Feedlots	1872.73	122.03	0.00
User Defined	0.00	0.00	0.00
Septic	276.69	108.37	0.00
Gully	0.00	0.00	0.00
Streambank	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00
Total	14367.99	2614.56	749.89

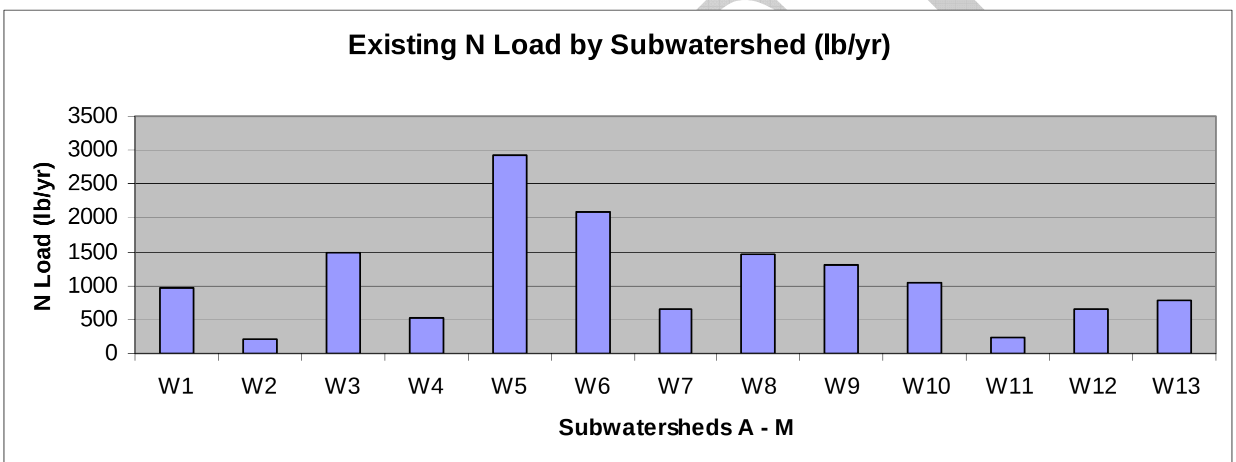

Figure 63. Nitrogen Loads by Subwatershed per Year with Existing BMPs

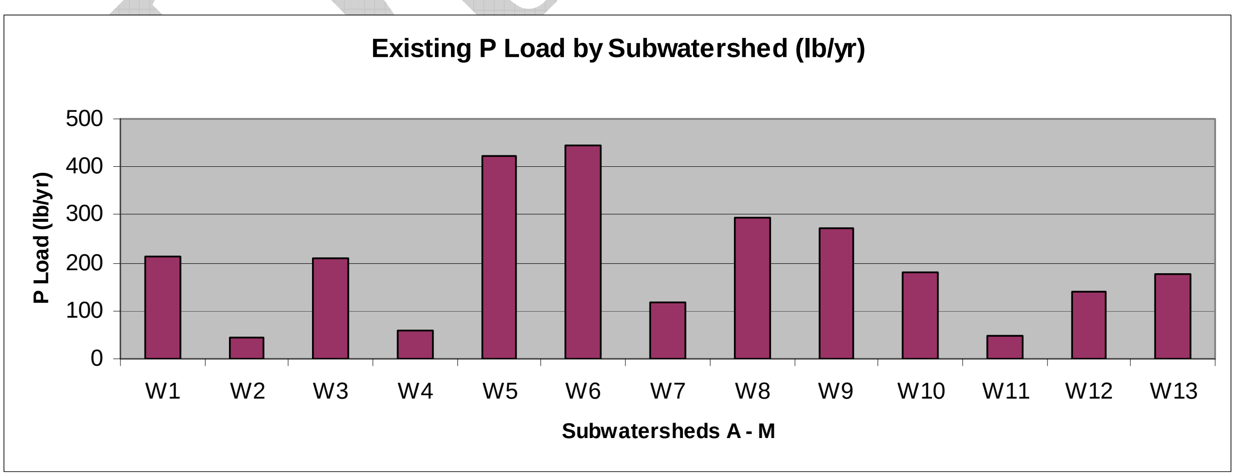

Figure 64. Phosphorous Loads by Subwatershed per Year with Existing BMPs

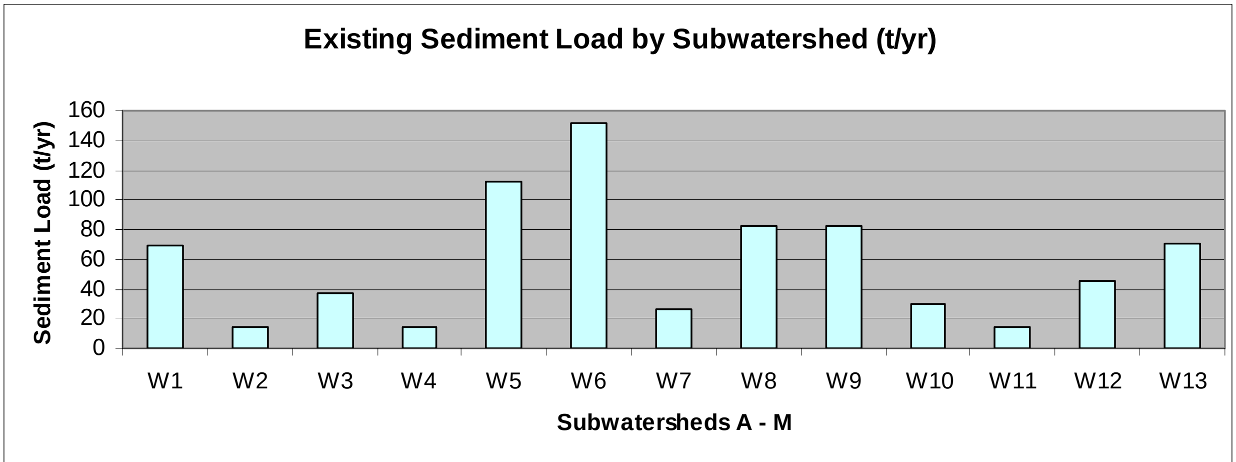

Figure 65. TSS Loads by Subwatershed per Year with Existing BMPs

5.5.3 Flow Modeling

Understanding the flow in a watershed is important because it determines the quantity of water entering the watershed, picking up pollutants, and flowing to a stream. Flow data for the UTRLA Watershed was obtained from the Long-Term Hydrologic Impact Assessment (LTHIA) modeling program, which considers land use, soil characteristics, and 30 years of precipitation data for a given watershed (Table 46).

Table 46. Flow Data for the UTRLA Watershed

Subwatershed	Area Acres	Flow Acre-ft./year
A	1289	378.97
B	257	64.82
C	869	138.82
D	297	59.53
E	1947	587.1
F	2600	839.33
G	841	159.73
H	1367	427.23
I	1306	444.91
J	740	117.04
K	214	76.22
L	735	181.31
M	1086	323.29
Total	13,548	3798.3

5.5.4 Pollutant Concentration Calculations

The pollutant to flow ratio is concentration, which shows where more pollutant is available to a constant amount of water. Concentrations of Nitrogen, Phosphorous, and TSS were calculated for each sub-watershed using the LTHIA flow data and the STEPL loading information (Table 47). The target standards are in concentrations so when comparing the pollutant concentrations, as opposed to the pollutant loads, to the standards it is easier to see the degree of impairment.

Table 47. Calculated Average Annual Pollutant Concentrations by Subwatershed

STEPL #	Subwatershed	Nitrogen mg/liter	Phosphorus mg/liter	Total Suspended Solids mg/liter
W1	A	0.9	0.2	133.4
W2	B	1.2	0.2	160
W3	C	4	0.6	197.7
W4	D	3.4	0.4	181.2
W5	E	1.8	0.3	139.1
W6	F	0.9	0.2	131.2
W7	G	1.5	0.3	120.4
W8	H	1.3	0.2	141.3
W9	I	1.1	0.2	137
W10	J	3.3	0.6	189.4
W11	K	0.7	0.1	90
W12	L	1.3	0.3	176.4
W13	M	0.9	0.2	158

The water quality limits for Total Nitrogen, Total Phosphorus, and Total Suspended Solids listed in Table 22 were compared to the calculated pollutant concentrations from each subwatershed for each parameter. All of the subwatersheds in the UTRLA Watershed exceeded the limits for all of the parameters.

Figure 66 shows the subwatersheds with the three highest loads for TN, TP, and TSS. Subwatershed F has the highest TP and TSS loads and the second highest TN load. Subwatershed E has the highest TN load and the second highest TP and TSS loads. Subwatershed C has the third highest TN load. Subwatershed H has the third highest TP load, and Subwatershed I has the third highest TSS load.

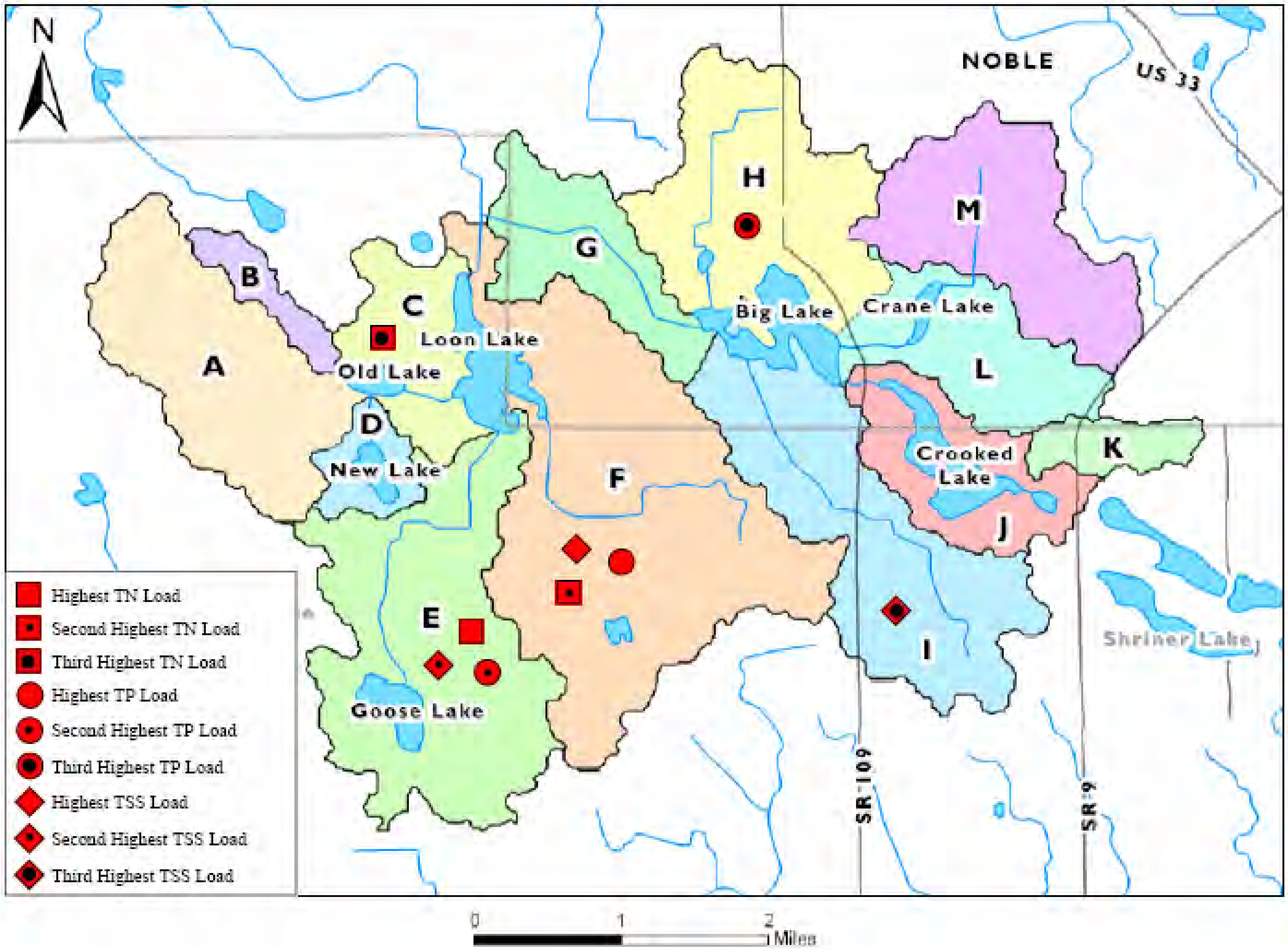

Figure 66. STEPL Results – Highest Pollutant Loads with Existing BMPs

5.6 HYDROLOGIC BUDGET

No direct flow measurements were made on any of the lake inlets or outlets during this study; however, estimates can be made by using data from USGS monitoring stations on similar watersheds nearby. The closest active USGS monitoring station with a similar watershed to be used for these estimates is the station on the Tippecanoe River at North Webster, Indiana (Glatfelter et al, USGS IN-88-1, 1988). Average flows estimated for each lake watershed within the study area were calculated by multiplying the average annual discharge per square mile (cfs-m) at the USGS monitoring gauge by the area of interest. Table 48 presents the data from the USGS station used to estimate the annual discharge for the lakes included in this study.

Table 48. Data from USGS Station used to Estimate Discharge at UTRLA Lakes

Station ID	Station Description	Discharge Area (mi^2)	Average Annual Discharge (cfs)	Period of Record	cfs/mi^2
03330241	Tippecanoe River at North Webster	49.3	47.2	20	0.957

The following subsections detail each lake and the various hydraulic characteristics. The annual discharge describes the volume of water that passes through the lake in one year's time. The areal water load is equal to the annual discharge divided by the lake's surface area and describes the volume of water per unit of surface area. The flushing rate is the number of times per year the entire lake volume is replaced by inflowing water. The water residence time is the inverse of the flushing rate and describes how many years it takes to replace the entire lake volume. The phosphorus retention coefficient describes what percentage of the phosphorus entering the lake will remain, rather than pass through the outlet. The phosphorus retention coefficient was determined using the empirical equation developed by Kirchner and Dillon (1975).

5.6.1 Big Lake

The Big Lake watershed includes the Crane and Crooked Lake watersheds and is 8.81 square miles in size. The estimated average annual discharge from the Big Lake watershed is 8.43 cfs (0.24 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Big Lake are presented in Table 49.

Table 49. Hydraulic Characteristics of Big Lake

Parameter	Value
Annual Discharge	6,927,303 m^3/yr
Areal Water Load	8.16 m/yr
Flushing Rate	1.08 times per year
Water Residence Time	0.9 years (329 days)
Phosphorus Retention Coefficient	57 percent
Watershed to Water Ratio	25:1

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5.6.2 Crooked Lake

The Crooked Lake watershed is 1.5 square miles in size. The estimated average annual discharge from the Crooked Lake watershed is 1.43 cfs (0.04 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Crooked Lake are presented in Table 50.

Table 50. Hydraulic Characteristics of Crooked Lake

Parameter	Value
Annual Discharge	1,274,760 m^3/yr
Areal Water Load	1.53 m/yr
Flushing Rate	0.12 times per year
Water Residence Time	8.2 years (2995 days)
Phosphorus Retention Coefficient	76 percent
Watershed to Water Ratio	5:1

5.6.3 Crane Lake

The Crane Lake watershed is 2.85 square miles in size. The estimated average annual discharge from the Crane Lake watershed is 2.72 cfs (0.07 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Crane Lake are presented in Table 51.

Table 51. Hydraulic Characteristics of Crane Lake

Parameter	Value
Annual Discharge	2,433,269 m^3/yr
Areal Water Load	21.47 m/yr
Flushing Rate	5.53 times per year
Water Residence Time	0.2 years (73 days)
Phosphorus Retention Coefficient	57 percent
Watershed to Water Ratio	65:1

5.6.4 Goose Lake

The Goose Lake watershed is 1.44 square miles in size. The estimated average annual discharge from the Goose Lake watershed is 1.38 cfs (0.04 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Goose Lake are presented in Table 52.

Table 52. Hydraulic Characteristics of Goose Lake

Parameter	Value
Annual Discharge	1,232,001 m^3/yr
Areal Water Load	3.62 m/yr
Flushing Rate	0.47 times per year
Water Residence Time	2.1 years (767 days)
Phosphorus Retention Coefficient	69 percent
Watershed to Water Ratio	11:1

5.6.5 Loon Lake

The Loon Lake watershed includes the Goose, New and Old Lake's watersheds and is 9.62 square miles in size. The estimated average annual discharge from the Loon Lake watershed is 9.21 cfs (0.26 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Loon Lake are presented in Table 53.

Table 53. Hydraulic Characteristics of Loon Lake

Parameter	Value
Annual Discharge	8,235,164 m^3/yr
Areal Water Load	9.17 m/yr
Flushing Rate	1.18 times per year
Water Residence Time	0.8 years (292 days)
Phosphorus Retention Coefficient	55 percent
Watershed to Water Ratio	28:1

5.6.6 New Lake

The New Lake watershed is 0.46 square miles in size. The estimated average annual discharge from the New Lake watershed is 0.44 cfs (0.013 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for New Lake are presented in Table 54.

Table 54. Hydraulic Characteristics of New Lake

Parameter	Value
Annual Discharge	396,859 m^3/yr
Areal Water Load	1.96 m/yr
Flushing Rate	0.29 times per year
Water Residence Time	3.6 years (1315 days)
Phosphorus Retention Coefficient	75 percent
Watershed to Water Ratio	6:1

5.6.7 Old Lake

The Old Lake watershed is 2.42 square miles in size. The estimated average annual discharge from the Old Lake watershed is 2.31 cfs (0.07 m^3/s) using the average cfs/mi^2 calculated in Table 48. Based on this estimate, various hydraulic parameters for Old Lake are presented in Table 55.

Table 55. Hydraulic Characteristics of Old Lake

Parameter	Value
Annual Discharge	2,065,806 m^3/yr
Areal Water Load	15.95 m/yr
Flushing Rate	2.81 times per year
Water Residence Time	0.4 years (146 days)
Phosphorus Retention Coefficient	44 percent
Watershed to Water Ratio	48:1

5.6.8 Summary of Hydrologic Budget

The lake residence times range from 0.2 and 0.4 years (73 and 146 days) for Crane and Old Lakes to 3.6 and 8.2 years (1,315 and 2,995 days) for New and Crooked Lake. The average hydraulic residence time indicated in a study of nearly 100 lakes was 2 years (Reckhow, 1980). The dramatic fluctuations in residence time can be explained by comparing the size of the watershed to the size of the water body. A large watershed draining into a small body of water will create a short hydraulic residence time or water constantly moving through the lake. Inversely, a small watershed draining in to a larger body of water will create a longer hydraulic residence time, meaning it will take years for the water to be completely replaced. The ratio of watershed acres to lake surface acres is listed for each lake. The ratio for glacial type lakes is typically between 10:1 and 20:1, the next consideration would be reservoirs which are characteristically over 100:1 (Holdren, 2001).

The residence time estimates and the watershed to water ratio play a large part in making decisions about lake management issues. Lakes with a short residence time and a large watershed will benefit from Best Management Practices installed in the watershed. Lakes with a long residence time will benefit from in lake practices.

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SECTION 6.0 WATERSHED MANAGEMENT ISSUES

This section takes a look at the highest priority pollutants causing water quality issues in the UTRLA Watershed, and the potential sources of these issues.

6.1 PRIORITY POLLUTANTS

Based on the public concerns, steering committee input, and baseline conditions, the primary pollutants of concern in the UTRLA Watershed are TSS, phosphorus, and nitrogen. *E. coli* was also suggested as a concern by residents of the UTRLA Watershed during the course of this study.

6.1.1 Total Suspended Solids

The USEPA has established TSS as the primary pollutant of concern in non-point source stormwater runoff. This is based on a correlation of TSS with the presence of nutrients, pathogens (i.e. *E. coli*), and other pollutants of concern. Therefore, USEPA asserts that reductions in TSS loads will result in an overall improved water quality. STEPL results indicate the majority of the stormwater runoff sediment load in the watershed comes from agricultural land, and the land use with the second largest sediment load is residential. Most of the BMPs recommended in this study will reduce the sediment load in UTRLA Watershed, consequently reducing nutrient loads as well.

6.1.2 Nutrients

Excessive nutrient loads, phosphorus particularly, appear to be present in the watershed based on the water chemistry sampling and STEPL modeling. The total phosphorus and Orthophosphorus concentrations exceeded minimum recommended concentrations of 0.1 mg/L for each at almost all of the sampling sites during baseflow conditions and at some of the sites during stormflow conditions. The different forms of nitrogen exceeded the minimum recommended concentrations at some sites, however is not considered to be as high a priority as phosphorus. High phosphorus levels with the presence of moderate levels of nitrogen in freshwater systems leads to excessive primary productivity in the form of algae, noxious weeds, and other unwanted vegetation and makes the system more prone to diurnal fluctuations in DO that can produce fish kills. Resultant biodiversity and higher trophic-level productivity in these tributaries is likely inhibited.

6.1.3 *E. coli*

High *E. coli* concentrations suggest the presence of other pathogens. These pathogens may impair the tributaries biota and limit the opportunity for human use of the creeks. Common sources of *E. coli* are livestock, manure application, malfunctioning or non-existent septic systems, wildlife, and domestic pets. *E. coli* levels in the UTRLA Watershed were below the state's standards of 235 colonies/100mL for primary human contact at all but two of the sampling sites. One of the sites only exceeded the standard by 5 colonies/100mL. Although the standard was exceeded by 273 colonies/100mL at the other site, this level is still well below the average range of *E. coli* levels in Indiana.

"Mean values (of *E. coli*) in hundreds of stations (in Indiana) measured by IDEM ranged from 0.2 CFU/100mL to 800,000 CFU/100mL. High *E. coli* values are clearly not unusual in Indiana streams. Sampling in tributaries of Eagle Creek have found levels as high as 160,000 CFU/100 mL, or about 680 times the maximum allowed for recreation. Less than half the samples taken would meet recreation standards. Over 800 samples were collected in the St. Joseph River (the water supply for Fort Wayne) and its tributaries in 1996-1997. The figure below shows the range of values during the sampling season (April-November) in 1996. The average of all samples was about 2,000 CFU/100 mL (16 times the maximum allowed), with a maximum of 35,200 CFU/100 mL" (Frankenberger, 2001).

Sampling conducted by a Hoosier Riverwatch volunteer monitor at these sites also resulted in *E. coli* levels (2,000 colonies/100 mL) above the state's standard, but they were still at the low end of the typical range of *E. coli* concentrations in Indiana. A more thorough watershed assessment was conducted in the subwatersheds of these sampling sites. The only visible source of *E. coli* identified was a small livestock operation, which had a pasture sloped downward toward the Loon Lake South Inlet. This sloped pasture was experiencing significant erosion. The eroding sediment was assumed to be carrying *E. coli* with it to the inlet. Since this sampling was conducted, this livestock operation has sold many of its cows, implemented rotational grazing, and installed a sediment trap. The reduced livestock numbers and the rotational grazing has allowed the pasture to regain full vegetative cover, and the sediment trap will allow sediment and the nutrients and pathogens attached to the sediment to settle out before they can be carried downstream. Additional sampling should be conducted at this site to determine the effectiveness of these BMPs.

As for the other sites experiencing *E. coli* concentrations above the state standard, but no visible sources were identified, the sampling was conducted after a significant storm event that followed a long dry spell in the area. During the dry period, in which the intermittent tributaries were not flowing, bacteria levels built up on the land. The storm event flushed the built up bacteria into the tributaries resulting in elevated *E. coli* counts, which are not present on a regular basis.

Although these high *E. coli* levels are not a normal occurrence, they warrant some concern. Many of the BMPs recommended in this plan will reduce *E. coli*, and bacteria levels should be monitored regularly in the future.

6.2 POTENTIAL SOURCES

The following sections describe the potential sources of the priority pollutants in this study. The specific pollutants that may be loaded into the UTRLA Watershed by each of these sources and the manner in which this happens is explained below.

6.2.1 Conventional Tillage

Based on tillage transects, both Noble and Whitley Counties have low conventional till rates for corn. Conventional tillage loosens the soil when the crops are removed and leaves the soil exposed throughout the winter, making it more susceptible to erosion. STEPL results indicate the majority of suspended sediment in runoff is generated from agricultural land. Nutrients and pathogens that are bound to sediment are also carried to tributaries in this manner. In addition, conventional tillage requires greater fertilizer application than conservation tillage in order to replace the nutrients lost from erosion. When fields that practice conventional tillage are paired with highly erodible soils, inadequate buffers, or manure application an even greater amount of sediment, nutrients, and pathogens are likely to be carried to tributaries via runoff. The acreages of conventional tillage in the subwatersheds of the UTRLA Watershed are shown in Table 56. Although none of the subwatersheds in UTRLA Watershed have high percentages of conventional tillage, for comparison between the subwatersheds, F, E, and I have the largest acreages of conventional tillage.

Table 56. Acres of Conventional Tillage by Subwatersheds

Subwatershed	Row Crop acres	Conventional Tillage acres
A	841	210
B	166	41
C	150	37
D	129	32
E	1315	329
F	1902	437
G	508	102
H	917	183
I	978	235
J	59	14
K	147	37
L	527	105
M	995	199
Total	8634	1961

6.2.2 Areas Lacking Buffer Strips

Buffers are, according to The U.S. Department of Agriculture, Natural Resource Conservation Service's *Conservation Practice Standard, Filter Strip, 393*A, grassed or forested areas that extend 30 feet from either side of a stream. Buffers can also be located along ditches, roads, and contours within a field, and are an extremely effective way of slowing runoff down and filtering out potentially harmful substances such as sediment, nutrients, animal waste, and chemicals from fertilizers, pesticides, herbicides, etc. They are especially important when located along conventionally tilled fields, fields containing highly erodible soils, fields to which manure has been applied, or fields or lawns to which fertilizer is applied because they filter out some of the sediment, nutrients, and pathogens associated with those practices. A lack of adequate buffers has been observed in certain areas in the watershed, especially along the Crane Lake Inlet in Subwatershed M, along the Tippecanoe River in Subwatershed G, along Friskney Ditch in Subwatershed F, along Sell Ditch in Subwatershed I, and along Haroff Branch and Stuckman Ditch in Subwatershed H. These areas are identified in Figure 38. Table 57 shows the percent of inadequate buffers by subwatershed and Figures 67 and 68 show examples of inadequate buffers, adequate grassed buffers, and forested buffers.

Table 57. Buffer Percentages by Subwatershed

Subwatershed	Forested Buffers %	Grassed Buffers %	Inadequate Buffers %	Residential Lawn %
A	32	25	42	0
B	0	23	60	17
C	57	0	20	22
D	44	22	10	24
E	52	12	32	3
F	14	4	81	1
G	14	0	82	4
H	30	1	64	5
I	20	4	66	10
J	70	0	3	27
K	91	0	0	9
L	54	0	38	8
M	0	0	100	0

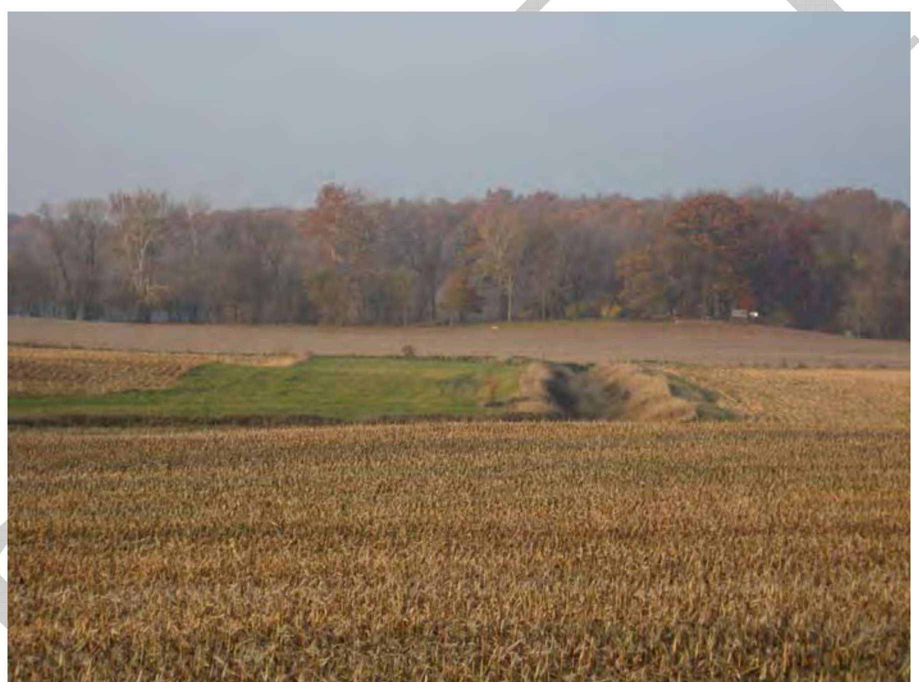


Figure 67. Adequate Grassed Buffer (Left Side) and Inadequate Buffer (Right Side)

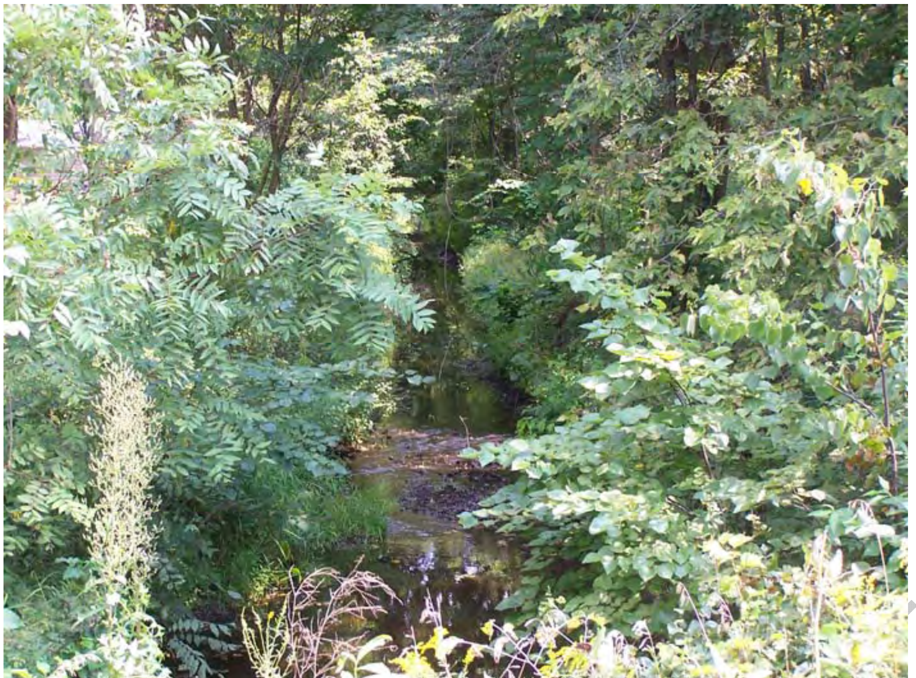


Figure 68. Adequate Forested Buffer

6.2.3 Bank Erosion

Bank erosion was observed in several areas in the Crooked Lake subwatershed (J), and may be occurring elsewhere in the UTRLA Watershed in areas not visible during the watershed survey or by aerial photography. Bank erosion adds sediment and attached nutrients or pathogens into the tributaries or lakes in which it is located. This type of erosion can be reduced by bank stabilization or grade stabilization practices. Noted locations of bank erosion can be seen in Figure 41. Figure 69 is a photo of streambank erosion in a tributary on the north side of Crooked Lake.

Figure 69. Streambank Erosion in Subwatershed J

6.2.4 Malfunctioning Septic Systems and Direct Sanitary Waste

Sewer systems have been installed on all of the inhabited lakes of the UTRLA Watershed between 1993-2001. Table 58 lists the years that sewers were installed on each lake. Although this is a great step towards improved water quality in the watershed, there are residences located in areas outside of these sewer districts. Houses built before the year 1978, did not require a permit to install a septic system. Consequently, most of the septic systems installed prior to that time are not currently up to code and many of them may likely be failing, if at all present. It is assumed that all houses outside of the known sewer districts in the UTRLA Watershed use septic systems or have been illegally connected to drain tiles. According to the Indiana State Department of Health, an estimated 25 percent of the septic systems in the state are inadequate or malfunctioning, and over 82,000 gallons of untreated wastewater per malfunctioning septic system is released into the environment every year (Lee *et al*., 2004). Based on the large amount of poorly drained soils in the UTRLA Watershed, it can be assumed that most of the septic systems in the watershed do not function properly. Clusters of 10 or more houses per quarter square mile in areas outside of the known sewer districts in the watershed were identified as potential threats of *E. coli* contamination from septic systems; particularly those with close proximity to a stream or ditch (see Figure 62). In addition to pathogens, malfunctioning or nonexistent septic systems contribute high concentrations of nutrients to tributaries as well.

Septic systems that have been appropriately installed and maintained should not be considered a source of *E. coli* or nutrient loading. There are many factors that can cause septic systems to malfunction, such as high seasonal water tables, limited leach field transmissivity due to areas of compact glacial till and bedrock interference, high transmissivity due to leach field interaction with quickly draining soils, and systems that have been illegally connected to drain tiles. These malfunctions could cause raw sewage to be discharged into receiving surface waters (IDEM, 2005).

Table 58. Year Sewers Installed at each Lake in the UTRLA Watershed

Lake	Year Sewer Installed
Big	2001
Crane	N/A
Crooked	1993
Goose	2001
Loon	2001
New	2001
Old	2001

6.2.5 Livestock

Animal manure contains large amounts of *E. coli*. Manure produced at CFOs and CAFOs is generally applied to pasture and cropland as fertilizer under a permit issued by IDEM. Although there are no CFOs or CAFOs in the UTRLA Watershed, manure may be hauled to another location for application, making it a potential source of *E. coli* in the watershed during stormwater runoff events. *E. coli* can be transported to streams and ditches by surface runoff or by leaching into tile drains, therefore fields with inadequate buffers, conventional tillage, highly erodible soils, or tile drainage systems contribute more *E. coli* to the watershed. Also affecting the *E. coli* load is the amount of time between manure applications and a storm event and the incorporation of manure into the soil.

Smaller farms with livestock within the watershed that do not require a permit may also be sources of *E. coli*, but on a much smaller scale. Overgrazed pastures or streambanks trampled by livestock may also load sediment into tributaries. Rotational grazing, nutrient management, fencing livestock away from tributaries, buffer strips, conservation tillage, and sediment traps are all BMPs recommended in this study that will reduce sediment, nutrient, and pathogens loads in the UTRLA Watershed.

6.2.6 Wildlife and Domestic Pets

Fecal matter contains pathogens and nutrients such as nitrogen and phosphorus, therefore any livestock manure or pet and wildlife waste entering a tributary or lake in the UTRLA Watershed is contributing to the *E. coli* and nutrient loads in the watershed. Fecal matter from wildlife can be directly deposited in tributaries or lakes or can be transported to the stream by runoff from the surrounding cropland, pastureland, and forested land (Figure 70). The fecal matter deposited by cats and dogs and transported by runoff to tributaries or lakes can also be a source of *E. coli* and nutrients. Remediation strategies for the other sources of *E. coli* and nutrients result in higher load reductions, therefore, more focus will be placed on these other sources. However, education and outreach is an effective approach to limit the *E. coli* and nutrient loads from wildlife and pets. Although many local governments have ordinances such as leash and pet clean-up laws or ordinances, some pet owners neglect to collect the wastes left behind. An ordinance would be difficult to enforce; however, educational methods to create an understanding of pets and their effect on water quality will improve voluntary cooperation.

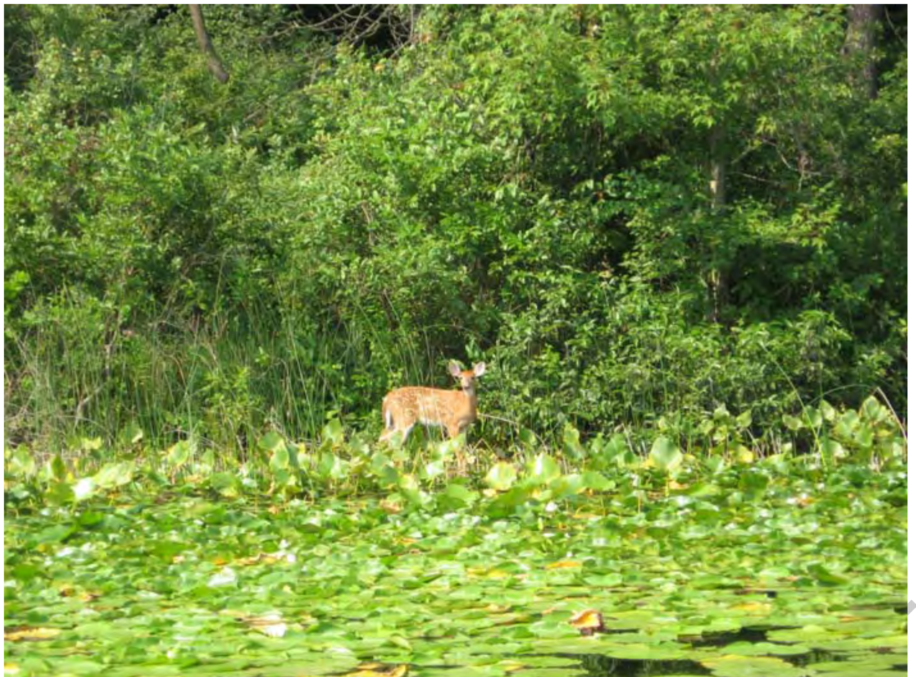


Figure 70. Deer Using New Lake as a Drinking Water Source

6.2.7 Tile Drains

A study on Leary Weber Ditch in Hancock County investigated agricultural chemical movement in overland flow and tile drains. The study showed that during most storms and between storms, tile drains are the most important contributor for the movement of agricultural chemicals to Leary Weber Ditch. Other studies are being conducted that may link the hypoxic zone or "dead zone" in the Gulf of Mexico to high nitrogen loads from agricultural drainage in the Midwest to the Mississippi River. These studies have also found high nitrogen concentrations in tile drains. Agricultural fertilizers, manure application, conventional tillage, and the spacing of the tile drains all influence the amount of nitrogen entering tile drains.

Based on the large amounts of poorly drained soils and the emphasis on agriculture in the UTRLA Watershed, it is assumed that a large portion of the agricultural land utilizes tile drainage systems. Although nutrient loads from tile drains were not measured as part of this study, based on the studies mentioned above and the presumed prevalence of tile drainage systems in the watershed, it can be assumed that tile drains are one of the largest sources of nutrient loading in the UTRLA Watershed.

6.2.8 Agricultural Fertilizers

Phosphorus and nitrogen are the primary limiting nutrients in agricultural row crops. Consequently, agricultural fertilizers contain large amounts of phosphorus and nitrogen. Soybeans can fix nitrogen from the atmosphere, while corn cannot. Therefore, corn requires more N containing fertilizers. When fertilizers are overused, the excess nutrients remain in the soil and are readily lost to tile drains or runoff during rain events. Soil analysis should be conducted prior to applying fertilizers, to determine the amount and type of nutrients needed. If a rain event occurs between fertilizer application and nutrient uptake by the crops, a great deal of nutrients can be lost to tile drains or runoff. Winter cover crops can reduce the amount of nutrients entering tributaries and tile drains by uptaking the excess nutrients from fertilizers or plant decomposition after crops are harvested. Crop rotations can reduce the amount of fertilizers needed because after corn has depleted the nitrogen in the soil, soybeans can fix nitrogen from the air. When the soybeans decompose, they return nitrogen to the soil which can be used by corn.

Almost 500 thousand pounds of nitrogen fertilizers and almost 400 thousand pounds of phosphorus fertilizer are estimated to be applied to the UTRLA Watershed per year. Most of the nutrients in these fertilizers are assumed to be used up by crops or filtered out of runoff by buffers, and are therefore not considered to be a major threat to water quality. However, areas with inadequate buffers or areas practicing conventional tillage release more nutrients, further supporting that an emphasis be placed on installing buffers and practicing conservation tillage or no-till.

6.2.9 Lawn Fertilizers

Fertilizers contain large amounts of phosphorous and some nitrogen. Homeowners are much more likely than farmers to overuse fertilizer since it costs less to treat a lawn than it does an entire field. Vegetation can only use so many nutrients at a time, therefore when fertilizers are overused the plants cannot use all the nutrients contained in those fertilizers. The excess nutrients bind with soil particles and are susceptible to run off into tributaries or lakes. Fertilizers are commonly the largest source of nutrients that cause algal blooms and aquatic weed growth.

6.2.10 Residential Development

During construction, soil is left bare making it susceptible to erosion. Indiana requires that construction sites over one acre in size obtain a Rule 5 permit from IDEM, which regulates the use of erosion control practices on the site. Sites less than one acre, as many of the construction sites in the UTRLA Watershed are, however, do not have regulations on the use of erosion control practices. These sites are highly susceptible to erosion, and therefore, are sources of sediment and the attached nutrients and pathogens to tributaries and lakes. Figure 71 is a photo of a construction site on Loon Lake with no erosion control practices. It can be seen how susceptible the exposed soil is to erosion into the lake during a rain event.

Figure 71. Construction Site with no Erosion Control Practices

6.2.11 Education

Many educational programs concerning water quality exist; however, may not be widely known or distributed. Through the strategic planning process of this study, the UTRLA steering committee has decided to form an education sub-committee to relay to the residents of the watershed how their everyday activities affect water quality. Tasks to be carried out by this sub-committee are listed in section 4.4.1.

SECTION 7.0 SUBWATERSHED ASSESSMENT

To gain an understanding of the areas with the greatest impairments and degradation in the UTRLA Watershed, a subwatershed assessment was conducted. In this assessment, baseline conditions and potential causes and sources of water quality impairments were ranked by subwatershed. This allows the subwatersheds with the greatest impairments to be identified, and targeted for future remediation. The following tables are used to prioritize the subwatersheds. The subwatersheds given a lower rank in these tables are regarded as higher priority for the corresponding parameter.

7.1 IDEM STUDIES

7.1.1 IDEM's 305(b) Water Quality Assessment

Under IDEM's 305(b) Water Quality Assessment Report the aquatic life use and primary contact use for each of the lakes and major tributaries in the UTRLA Watershed were assessed. The Tippecanoe River in subwatershed G was not supportive of primary contact use or aquatic life use, while Crooked Lake in subwatershed J was only partially supportive of aquatic life uses and not supportive of Fish Consumption (Tables 59 - 61).

Table 59. Subwatershed Rank by IDEM's Water Quality Assessment for Primary Contact Use

Subwatershed	Primary Contact Use	Rank
G	N	1
N = no supporting; P = fully supporting; F = fully supporting		

Table 60. Subwatershed Rank by IDEM's Water Quality Assessment for Aquatic Life Use

Subwatershed	Aquatic Life Use	Rank
G	N	1
J	P	2
N = no supporting; P = fully supporting; F = fully supporting		

Table 61. Subwatershed Rank by IDEM's Water Quality Assessment for Fish Consumption

Subwatershed	Primary Contact Use	Rank
J	N	1
N = no supporting; P = fully supporting; F = fully supporting		

7.1.2 IDEM's 303(d) List of Impaired Waters

The Tippecanoe River (subwatershed G) was placed on IDEM's 2006 303(d) list because it is impaired for dissolved oxygen, *E. coli*, and nutrients. Crooked Lake in subwatershed J was placed on IDEM's 2006 303(d) list because it is impaired for mercury and biotic communities. The subwatersheds were ranked by the number of impairments in Table 62.

Table 62. Subwatershed Rank by IDEM's 2006 303(d) List

Subwatershed	# of Impairments	Rank
G	3	1
J	2	2

7.2 TRIBUTARY WATER CHEMISTRY

Subwatersheds were ranked by the concentrations of each of the parameters tested, with those having the highest concentrations receiving the lowest rank. The concentrations were averaged in those subwatersheds with more than one sampling site.

7.2.1 Total Phosphorus

During baseflow conditions subwatersheds F, H, and K had the highest TP concentrations, while subwatersheds I, J, and A had the lowest TP concentrations (Table 63). During storm flow conditions subwatersheds H, E, and J had the highest TP concentrations, while all of the other subwatersheds met the target concentration for TP of 0.1 mg/L (Table 64).

Table 63. Subwatershed Rank by TP Concentration (Baseflow)

Subwatershed	TP (mg/L)	Rank
F	2.7	1
H	1.75	2
K	1.4	3
B	0.5	4
L	0.5	4
E	0.41	6
A	0.4	7
J	0.37	8
I	0.35	9

Table 64. Subwatershed Rank by TP Concentration (Stormflow)

Subwatershed	TP (mg/L)	Rank
H	0.61	1
E	0.25	2
J	0.19	3
A	0.1	4
L	0.1	4
B	0.08	6
I	0.06	7
K	0.04	8
C	0.035	9
F	0.02	10

7.2.2 Orthophosphorus

During baseflow conditions subwatersheds F, H, and I had the highest Ortho-P concentrations, while subwatersheds L, K, B, and A had the lowest TP concentrations (Table 65). Subwatershed L was the only subwatershed that met the Ortho-P target concentration of 0.1 mg/L during baseflow. During stormflow conditions subwatersheds H, E, and J had the highest Ortho-P concentrations, while all of the other subwatersheds met the target concentration for Ortho-P (Table 66).

Table 65. Subwatershed Rank by Ortho-P Concentration (Baseflow)

Subwatershed	Ortho-P (mg/L)	Rank
F	0.65	1
H	0.33	2
I	0.3	3
E	0.2	4
J	0.19	5
A	0.14	6
B	0.14	6
K	0.14	6
L	0.1	9

Table 66. Subwatershed Rank by Ortho-P Concentration (Stormflow)

Subwatershed	Ortho-P (mg/L)	Rank
H	0.435	1
E	0.175	2
J	0.105	3
A	0.07	4
B	0.07	4
L	0.05	6
K	0.03	7
C	0.025	8
F	0.01	9
I	0.01	9

7.2.3 Nitrate

During baseflow conditions subwatersheds H, L, and I had the highest NO3 concentrations, while subwatersheds J, A, K, and F all met the target concentration for NO3 of 1 mg/L (Table 67). During stormflow conditions subwatershed L was the only subwatershed that did not meet the target NO3 concentration (Table 68).

Table 67. Subwatershed Rank by NO3 Concentration (Baseflow)

Subwatershed	NO3 (mg/L)	Rank
H	3.9	1
L	3.5	2
I	2.1	3
B	1.3	4
E	1.05	5
F	1	6
K	1	6
A	0.9	8
J	0.7	9

Table 68. Subwatershed Rank by NO3 Concentration (Stormflow)

Subwatershed	NO3 (mg/L)	Rank
L	1.8	1
H	1	2
J	0.9	3
E	0.8	4
C	0.75	5
F	0.6	6
A	0.3	7
B	0.3	7
I	0.3	7
K	0.3	7

7.2.4 Ammonia

During baseflow conditions all of the subwatersheds met the target concentration for NH3 of 1 mg/L, while during stormflow conditions subwatersheds B and C were the only subwatersheds that did not meet the target NH3 concentration (Tables 69 and 70).

Table 69. Subwatershed Rank by NH3 Concentration (Baseflow)

Subwatershed	NH3 (mg/L)	Rank
H	0.8	1
B	0.6	2
F	0.55	3
A	0.4	4
E	0.4	4
K	0.4	4
I	0.35	7
L	0.32	8
J	0.2	9

Table 70. Subwatershed Rank by NH3 Concentration (Stormflow)

Subwatershed	NH3 (mg/L)	Rank
B	1.3	1
C	1.1	2
H	1	3
F	0.9	4
E	0.85	5
J	0.8	6
A	0.7	7
I	0.7	7
L	0.7	7
K	0.6	10

7.2.5 Total Kjeldahl Nitrogen

During baseflow conditions subwatersheds F, H, and L had the highest TKN concentrations, while subwatersheds I, K, and E had the lowest concentrations. During stormflow conditions subwatersheds B, F, and H had the highest concentrations, while subwatersheds L, I, and A had the lowest concentrations (Tables 71 and 72).

Table 71. Subwatershed Rank by TKN Concentration (Baseflow)

Subwatershed	TKN (mg/L)	Rank
F	1.2	1
H	0.85	2
L	0.8	3
A	0.6	4
B	0.6	4
J	0.6	4
E	0.55	7
K	0.5	8
I	0.4	9

Table 72. Subwatershed Rank by TKN Concentration (Stormflow)

Subwatershed	TKN (mg/L)	Rank
B	1.5	1
F	1.3	2
H	1.3	2
E	0.85	4
J	0.8	5
K	0.8	5
A	0.7	7
I	0.7	7
L	0.7	7

7.2.6 Total Suspended Solids

During baseflow conditions none of the sampling sites had a TSS concentration above the highly protected level of 25 mg/L, while during stormflow conditions only subwatershed L exceeded 25 mg/L (Tables 73 and 74).

Table 73. Subwatershed Rank by TSS Concentration (Baseflow)

Subwatershed	TSS (mg/L)	Rank
F	17.5	1
I	14.5	2
J	13.5	3
H	11.5	4
K	8	5
B	7.5	6
L	7	7
E	5.75	8
A	2.5	9

Table 74. Subwatershed Rank by TSS Concentration (Stormflow)

Subwatershed	TSS (mg/L)	Rank
L	25.5	1
H	17	2
F	12.5	3
K	11.5	4
J	8.75	5
E	8.25	6
I	6.5	7
C	4.5	8
B	4	9
A	2.5	10

7.2.7 Dissolved Oxygen

During baseflow conditions subwatersheds J, I, and A had DO concentrations far exceeding the healthy range of 5-10 mg/L, while subwatersheds K, B, and H were all within the target range for DO concentrations (Table 75). During stormflow conditions subwatersheds H, I, A, and F were outside the target range for DO, while the other subwatersheds fell within the healthy range (Table 76).

Table 75. Subwatershed Rank by DO Concentration (Baseflow)

Subwatershed	DO (mg/L)	Rank
J	2.6	1
I	18.7	2
A	13	3
E	11.95	4
F	11.2	5
L	11	6
K	5.6	7
B	7.2	7
H	9.05	7

Table 76. Subwatershed Rank by DO Concentration (Stormflow)

Subwatershed	DO (mg/L)	Rank
H	3.9	1
I	18.7	2
A	4.7	3
F	10.5	4
L	5	5
J	5.2	5
B	5.3	5
K	6.2	5
E	7.2	5

7.2.8 pH

During baseflow conditions subwatersheds I and E had pH values exceeding the target range of 6.0 to 8.0 (Table 77). The pH values at all of the sampling sites fell within the target range during stormflow conditions; therefore they all received a rank of 1.

Table 77. Subwatershed Rank by pH (Baseflow)

Subwatershed	pH (SU)	Rank
I	8.5	1
E	8.4	2
A	8.0	3
F	8.0	3
L	7.9	3
H	7.85	3
B	7.7	3
K	7.5	3
J	7.25	3

7.2.9 Conductivity

During both baseflow and stormflow conditions, none of the sampling sites exceeded the target level of 2000 uS for conductivity. Therefore, all of the subwatersheds received a rank of 1.

7.2.10 Temperature

During baseflow conditions subwatersheds I, F, and E had the highest temperatures, while subwatersheds K, B, L, and J did not exceed the temperature of 19°C considered healthy for coldwater fish (Table 78). During stormflow conditions the temperature for all of the subwatersheds exceeded the target temperature, with subwatersheds F, E, and I having the highest temperatures (Table 79).

Table 78. Subwatershed Rank by Temperature (Baseflow)

Subwatershed	Temperature (°C)	Rank
I	25.9	1
F	22	2
E	21.65	3
H	21.65	4
A	21.2	5
K	18.2	6
B	16.5	7
L	15.8	8
J	13.65	9

Table 79. Subwatershed Rank by Temperature (Stormflow)

Subwatershed	Temperature (°C)	Rank
F	28.5	1
E	28.45	2
I	28	3
A	26.8	4
J	24.25	5
H	23.6	6
K	23.2	7
B	21.5	8
L	20	9

7.3 *E. COLI*

During baseflow conditions subwatershed L was the only subwatershed that exceeded the state standard for *E. coli* of 235 colonies/100 mL (Table 80). Subwatershed C was the only subwatershed that exceeded the *E. coli* standard during stormflow conditions (Table 81).

Table 80. Subwatershed Rank by *E. coli* Concentration (Baseflow)

Subwatershed	*E. coli* (colonies/100 mL)	Rank
L	240	1
E	100	2
I	59	3
A	38	4
F	4	5

Table 81. Subwatershed Rank by *E. coli* Concentration (Stormflow)

Subwatershed	*E. coli* (colonies/100 mL)	Rank
C	508	1
B	185	2
A	151	3

7.4 BIOLOGICAL SAMPLING

Subwatersheds were ranked by the scores calculated from both the macroinvertebrate sampling and the habitat evaluation, with those having the lowest scores receiving the lowest rank. The scores were averaged in those subwatersheds with more than one sampling site.

7.4.1 Macroinvertebrate Sampling

Subwatersheds A, K and L had the lowest macroinvertebrate scores and were therefore ranked of the highest priority. Subwatersheds B, I, and J had the highest scores, indicating they have the best water quality within the UTRLA Watershed (Table 82).

Table 82. Subwatershed Rank by Macroinvertebrate Bioassessment

Subwatershed	Average Macro Score	Rank
A	28	1
K	34	2
L	38	3
F	39	4
H	41	5
E	52	6
J	55	7
I	61	8
B	76	9

7.4.2 Habitat Evaluation

Subwatersheds H, I, and L had the lowest QHEI scores and were therefore ranked of the highest priority for habitat quality. Subwatersheds B, J, and E had the highest QHEI scores; however, these scores were still not fully supporting (Table 83).

Table 83. Subwatershed Rank by QHEI Assessment

Subwatershed	QHEI Score	Rank
H	36	1
I	37	2
L	38	3
F	39	4
A	42	5
K	43	6
E	49	7
J	51	8
B	55	9

7.5 WINDSHIELD SURVEY

Ranking analysis of the concerns observed during the windshield survey was based on the number of occurrences of the concern within each subwatershed.

7.5.1 Tillage Practices

The acreages of conventional tillage in the watershed were estimated based on the acres planted to corn and soybeans and the respective percentages of conventional tillage determined by the Tillage Transects. The subwatersheds with the most conventional tillage received lower ranks, while the subwatersheds with less conventional tillage were ranked higher. Based on this assessment, subwatersheds F, E, and I practiced the most conventional tillage, while subwatersheds J, D, K, and C practiced less conventional tillage (Table 84).

Table 84. Subwatershed Rank by Acres of Conventional Tillage

Subwatershed	Conventional Tillage Acres	Rank
F	437	1
E	329	2
I	235	3
A	210	4
M	199	5
H	183	6
L	105	7
G	102	8
B	41	9
C	37	10
K	37	10
D	32	12
J	14	13

7.5.2 Inadequate Buffers

The lengths of inadequate or nonexistent buffers, adequate grassed buffers, and adequate forested buffers were measured using ArcGIS. The percentages of inadequate buffers were then calculated. These percentages were ranked with subwatersheds having the highest percentages given the lowest rank and those with the lowest percentages given the highest rank. As shown in Table 85, subwatersheds M, G, and F had the highest percentages of inadequate buffers, while subwatersheds K, J, and D had the lowest percentages.

Table 85. Subwatershed Rank by Percentage of Inadequate Buffers

Subwatershed	% Inadequate Buffers	Rank
M	100	1
G	82	2
F	81	3
I	66	4
H	64	5
B	60	6
A	42	7
L	38	8
E	32	9
C	20	10
D	10	11
J	3	12
K	0	13

7.5.3 Bank Erosion

Bank erosion was ranked by the number of occurrences that were observed during the watershed survey. Subwatershed J was the only subwatershed that had visible bank erosion (Table 86).

Table 86. Subwatershed Rank by Bank Erosion

Subwatershed	# of Occurrences	Rank
J	3	1

7.5.4 Malfunctioning or Nonexistent Septic Systems

Subwatersheds were ranked by the number of unsewered communities, within the subwatersheds with the most communities receiving a lower rank and those with fewer communities receiving a higher rank. An unsewered community consists of 10 or more houses within a quarter square mile that is located outside of known sewer service districts. Subwatersheds I and A were the only subwatersheds that contained unsewered communities (Table 87).

Table 87. Subwatershed Rank by Unsewered Communities

Subwatershed	# of Unsewered Communities	Rank
I	3	1
A	1	2

7.5.5 Livestock

The number of livestock within each subwatershed was based on information from the USDA National Agricultural Statistics Service (NASS). The total weight of all the livestock in each watershed was calculated based on average weights of each animal type. The total weight was then divided by 100 lbs. The subwatersheds were then ranked by the weight of animals with subwatershed with the highest weights given a lower rank while the subwatershed with lower weights given a higher rank. Table 88 shows that subwatersheds H, E, and G had the largest amount of animals by weight, and subwatersheds D, B, and L had the smallest amount of animals by weight.

Table 88. Subwatershed Rank by Livestock

Subwatershed	# of units per 100 lbs.	Rank
H	1,110	1
E	572	2
G	302	3
C	240	4
A	200	5
M	160	6
L	88	7
B	65	8
D	29	9

7.5.6 Agricultural Fertilizers

The acreages of row crops in the subwatersheds of the UTRLA Watershed and the 2005 Indiana agricultural chemical application rates calculated by NASS, USDA were used to estimate amounts of agricultural chemicals applied to the UTRLA Watershed. These amounts were ranked by subwatershed with the subwatershed applying the most fertilizer having the lowest rank. Table 89 reveals that subwatersheds F, E, and M apply the most N fertilizer, while J, D, and C apply the least. Table 90 shows that subwatersheds F, E, and A apply the most P fertilizers, while subwatersheds J, K, and D apply the least.

Table 89. Subwatershed Rank by N Fertilizer Use

Subwatershed	N Fertilizers (lbs.)	Rank
F	101,226	1
E	66,329	2
M	61,601	3
H	56,812	4
I	53,098	5
A	42,067	6
L	32,901	7
G	31,708	8
K	9,578	9
B	7,537	10
C	6,474	11
D	5,575	12
J	4,184	13

Table 90. Subwatershed Rank by P Fertilizer Use

Subwatershed	P Fertilizers (lbs.)	Rank
F	106,827	1
E	70,414	2
A	44,632	3
M	33,063	4
H	30,471	5
I	29,439	6
L	17,712	7
G	17,002	8
B	8,008	9
C	6,885	10
D	5,909	11
K	5,184	12
J	2,237	13

7.6 POLLUTANT LOAD MODELING

Existing pollutant loads for the UTRLA Watershed were modeled using the STEPL program. STEPL modeled loads for TSS, Nitrogen, and Phosphorus based on soil, rainfall, and land use information as well as existing BMPs.

7.6.1 Total Suspended Solids

The STEPL program modeled the TSS load for each subwatershed in the UTRLA Watershed. The subwatersheds with higher loads were given a higher rank, while those with lower loads were given a lower rank. This analysis shows that subwatersheds F, E, and I have the highest loads of TSS while subwatersheds K, B, and D have the lowest loads (Table 91).

Table 91. Subwatershed Rank by TSS Load

Subwatershed	TSS Load (lb/yr)	Rank
F	151.2	1
E	111.9	2
I	83	3
H	82.8	4
M	70.6	5
A	68.9	6
L	44.9	7
C	37.3	8
J	30.1	9
G	26.3	10
D	14.4	11
B	14.3	12
K	14.3	12

7.6.2 Total Nitrogen

Again, the Total Nitrogen loads were calculated by the STEPL program. Subwatersheds E, F, and C have the highest TN loads while subwatersheds B, K, and D have the lowest loads (Table 92).

Table 92. Subwatershed Rank by TN Load

Subwatershed	TN Load (lb/yr)	Rank
E	2921.3	1
F	2091.7	2
C	1498.1	3
H	1469.7	4
I	1294.8	5
J	1040.9	6
A	969.6	7
M	793	8
L	665.9	9
G	645.3	10
D	534.6	11
K	223.4	12
B	219.6	13

7.6.3 Total Phosphorus

The loads for Total Phosphorus in each subwatershed were generated by the STEPL program. Subwatersheds F, E, and H had the highest loads, subwatersheds B, K, and D had the lowest loads (Table 93).

Table 93. Subwatershed Rank by TP Load

Subwatershed	TP Load (lb/yr)	Rank
F	446.6	1
E	422.1	2
H	292.7	3
I	270.8	4
A	213.8	5
C	208.4	6
J	178.3	7
M	177.9	8
L	139.3	9
G	116	10
D	58.5	11
K	46.2	12
B	44	13

7.7 RESULTS OF SUBWATERSHED ASSESSMENT

Once the subwatersheds were ranked for all of the water quality factors, the ranks were totaled and averaged. The averaged totals were then ranked to give the overall subwatershed rank (Table 94). Based on this subwatershed ranking assessment subwatersheds H, F, and E are of the highest priority, while subwatersheds D, K, and C are of the lowest priority. While this subwatershed ranking assessment gives a general idea of the water quality in the subwatersheds, it is not completely accurate. Some of the factors ranked in this assessment, such as conventional tillage were based on estimated not actual numbers. Also, there are other factors that should have been assessed, but did not fit into the assessment, such as the hydrologic budgets. The hydrologic budgets were lake specific, but many lakes sat in multiple subwatersheds and therefore could not be ranked by subwatershed. The hydrologic budget shows not only how long each lake holds on to its water, but also the nutrients in the water. The longer a lake holds on to nutrients, the higher the concentrations of the nutrients are. If the hydrologic budget was able to be included in the subwatershed ranking, then subwatersheds J and D would have been of much higher priority.

Table 94. Overall Subwatershed Rank

PARAMETERS	A	B	C	D	E	F	G	H	I	J	K	L	M
305(b) - aquatic life							1						
305(b) - primary contact							1			2			
305(b) – fish consumption										1			
303(d) List							1			2			
TP Concentration - baseflow	7	4			6	1		2	9	8	3	4	
TP Concentration - stormflow	4	6	9		2	10		1	7	3	8	4	
Ortho-P Concentration - baseflow	6	6			4	1		2	3	5	6	9	
Ortho-P Concentration - stormflow	4	4	8		2	9		1	9	3	7	6	
NO3 Concentration – baseflow	8	4			5	6		1	3	9	6	2	
NO3 Concentration – stormflow	7	7	5		4	6		2	7	3	7	1	
NH3 Concentration – baseflow	4	2			4	3		1	7	9	4	8	
NH3 Concentration – stormflow	7	1	2		5	4		3	7	6	10	7	
TKN Concentration – baseflow	4	4			7	1		2	9	4	8	3	
TKN Concentration – stormflow	7	1			4	2		2	7	5	5	7	
TSS Concentration – baseflow	9	6			8	1		4	2	3	5	7	
TSS Concentration – stormflow	10	9	8		6	3		2	7	5	4	1	
DO Concentration – baseflow	3	7			4	5		7	2	1	7	6	
DO Concentration – stormflow	3	5			5	4		1	2	5	5	5	
pH Value – baseflow	3	3			2	3		3	1	3	3	3	
Temperature – baseflow	5	7			3	2		4	1	9	6	8	
Temperature - stormflow	4	8			2	1		6	3	5	7	9	
E. coli Concentration - baseflow	4				2	5			3			1	
E. coli Concentration - stormflow	3	2	1										
Macro Score	1	9			6	4		5	8	7	2	3	
QHEI Score	5	9			7	4		1	2	8	6	3	
Conventional Tillage	4	9	10	12	2	1	8	6	3	13	10	7	5
Inadequate Buffers	7	6	10	11	9	3	2	5	4	12	13	8	1
Bank Erosion										1			
Septic Systems	2								1				
Livestock	5	8	4	9	2		3	1				7	6
Agricultural Fertilizers - nitrogen	6	10	11	12	2	1	8	4	5	13	9	7	3
Agricultural Fertilizers - phosphorus	3	9	10	11	2	1	8	5	6	13	12	7	4
TSS Load	6	12	8	11	2	1	10	4	3	9	12	7	5
TN Load	7	13	3	11	1	2	10	4	5	6	12	9	8
TP Load	5	13	6	11	2	1	10	3	4	7	12	9	8
TOTAL	153	184	95	88	110	85	62	82	130	180	189	158	40
AVERAGE	5.1	6.6	6.8	11	3.9	3.2	5.6	3	4.6	6	7.3	5.6	5
OVERALL RANK	6	10	11	13	3	2	7	1	4	9	12	7	5

SECTION 8.0 PROBLEM STATEMENTS

Based on the public concerns, steering committee input, and baseline conditions, three areas of primary concern were recognized; nutrients and sediment, education and outreach, and coordination with local officials.

8.1 NUTRIENTS AND SEDIMENT

Problem Statement:
Excess nutrients in the lakes of the UTRLA Watershed are supplementing the growth of aquatic weeds, which are placing limitations on the recreation, aesthetics, biota, and water quality of the watershed.

Discussion:
High nutrient concentrations and loads are evident in the UTRLA Watershed, especially phosphorus, based on the water chemistry sampling and STEPL modeling. Excess nutrients in an aquatic system spawn accelerated aquatic plant growth, especially algae and other aquatic weeds. These weeds limit water sports, out-compete aquatic plants that provide habitat for fish and other aquatic organisms, may be unpleasing to the eye, and ultimately contribute to the eutrophication of the lakes in the watershed.

8.2 EDUCATION AND OUTREACH

Problem Statement:
Educational programs involving water quality need to be expanded upon in the UTRLA Watershed.

Discussion:
Education through ongoing efforts of many entities in the watershed needs to be coordinated and increased. Education through public meetings, BMP demonstrations, literature distribution, news articles, and discussion of existing ordinances will help to increase public awareness of the issues within the watershed. Topics of the needed educational programs include proper installation and maintenance of septic systems, proper fertilizer use, proper pet waste disposal, land stewardship, wildlife management, agricultural BMPs, and development pressure. Increased public awareness will help citizens understand the interconnectivity of water quality, the watershed and their everyday lives.

8.3 COORDINATION WITH LOCAL OFFICIALS

Problem Statement:
Coordination regarding water quality between members of the UTRLA steering committee and local officials needs to be strengthened.

Discussion:
Involving local and government officials in the decisions and activities of the UTRLA steering committee will keep the officials up to date on local water quality issues. Involving members of the UTRLA steering committee in local government events, such as planning commission or zoning meetings, will help to incorporate the ideas and opinions of the watershed residents in local government decisions.

SECTION 9.0 CRITICAL AREAS

Critical areas were identified and prioritized by a combination of the public concerns, steering committee input, baseline conditions, and the subwatershed ranking assessment. Each subwatershed is a critical area. The prioritization of the critical areas is shown in Table 95 and Figure 72. The BMPs recommended for each subwatershed to help alleviate water quality problems were shown previously in Figures 48 through 52. Table 96 provides descriptions of these remediation types. A list of BMPs from the USDA, NRCS Field Office Technical Guide (FOTG) is included as Appendix G.

Table 95. Prioritization of the Subwatersheds

Subwatershed	Prioritization
H	High
F	High
J	High
E	Moderate
M	Moderate
B	Moderate
C	Moderate
I	Low
A	Low
G	Low
L	Low
K	Low
D	Low

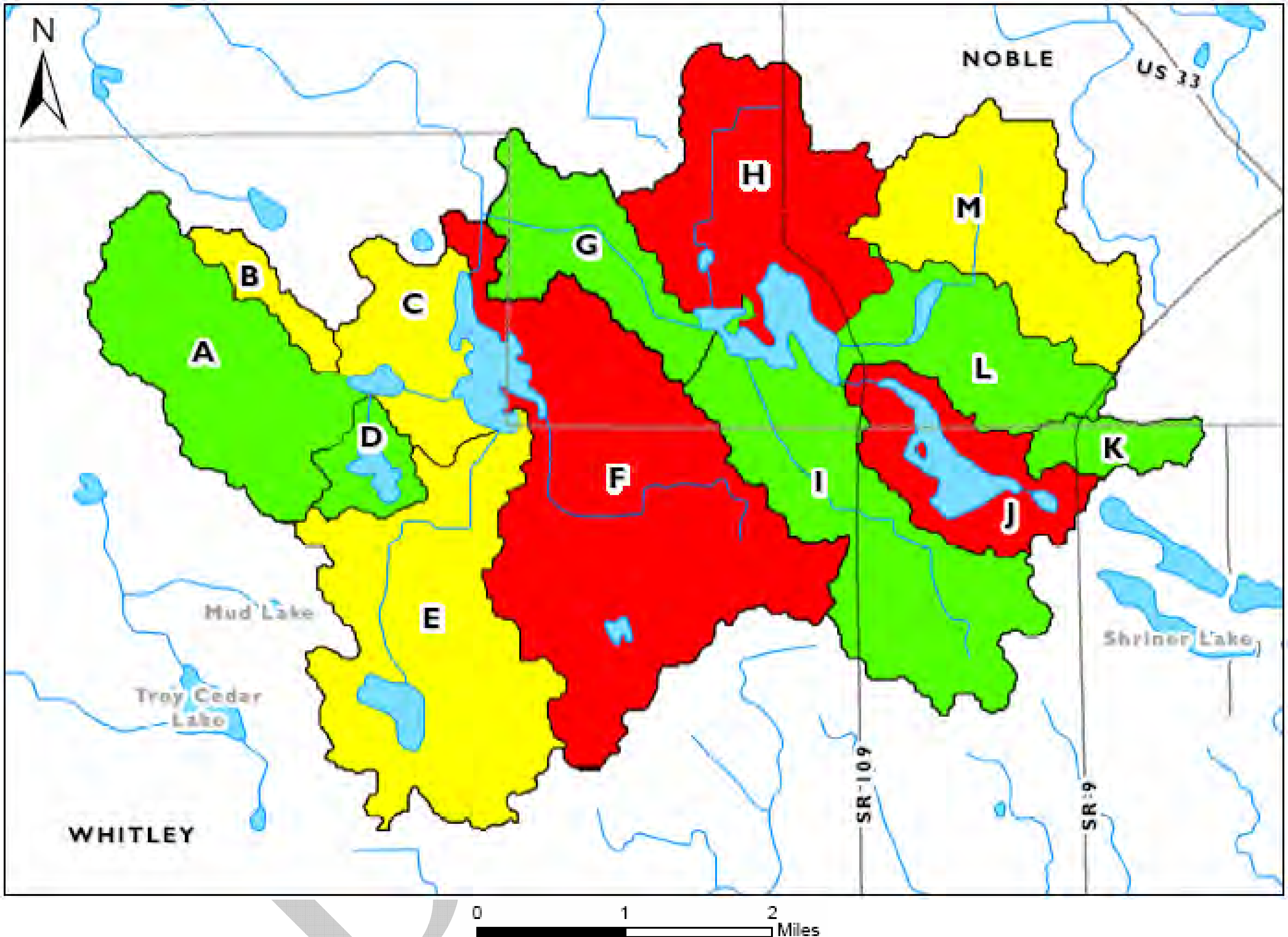
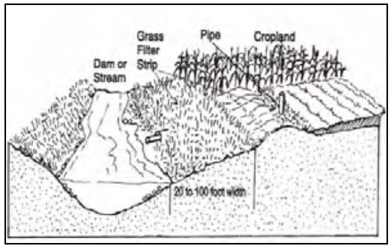
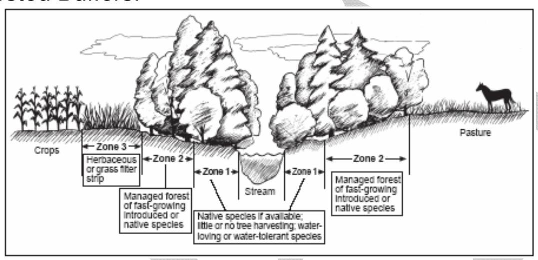
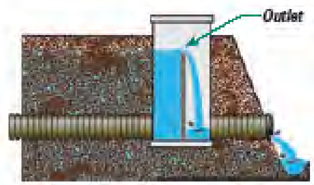
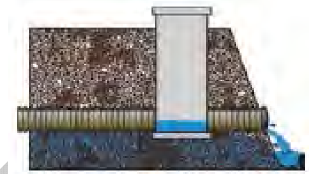
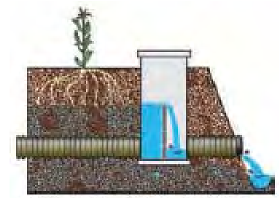


Figure 72. Prioritized Subwatersheds

Table 96. Potential Remediation Types Explanations for BMPs listed in Tables 44-47. *Explanations listed in alphabetical order*.

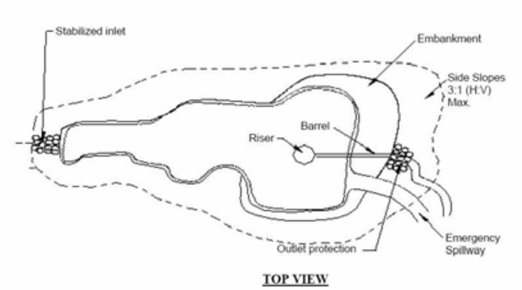
Aquatic Plant Management	Chemical: The use of herbicides to remove weeds that when applied correctly do not harm fish and other aquatic species. May be used to treat certain types of plants while leaving others unaffected. Is usually only a temporary solution, target species usually reappear requiring retreatment. Mechanical: The removal of weeds and their root system using a mechanical device. Motor driven underwater weed harvesters are available for large bodies of water and handheld devices are available for smaller areas. Must be operated several times during the growing season. Bottom Barriers: Blanket-like barriers are placed on the bottom of a waterbody compressing aquatic plants and blocking out sunlight. Hand Harvesting: Uprooting aquatic plants by hand-pulling, only suitable for small areas.
Bioretention Filters	Bioretention filters use the chemical, biological, and physical properties of plants and soils to remove pollutants from stormwater runoff.  WCC

Buffers/Filter Strips	A buffer/filter strip is a vegetated area located between a human land use and a water body, which traps and absorbs sediment, nutrients, and other pollutants from sheet flow off of the human land use before it reaches the water body. Buffers have been shown to reduce sediment loads by 50 – 90%, Total P by 20 – 90%, Total N by 63 – 76%, depending on the type and width of installed buffer (Coote and Gregorich, 2000). Grassed Buffers:  Purdue University Cooperative Extension Service  USDA Natural Resource Conservation Service Forested Buffers:  USDA Natural Resource Conservation Service  USDA Natural Resource Conservation Service
Conservation Easement	A conservation easement is a voluntary, written agreement in which a landowner agrees to restrict the use of their land in exchange for certain tax and estate-planning benefits.

Drainage Water Management	In Drainage Water Management the removal of surface or subsurface runoff is controlled by water-control structures. Water is retained during dry periods to provide moisture for crops, and released during wet months to prevent pooling in fields or over saturating crop roots. Drainage Water Management Structures (shown below) have been found to reduce annual nitrate loads by 15 – 75%.  **Figure 1.** *The outlet is raised after harvest to reduce nitrate delivery.*  **Figure 2.** *The outlet is lowered a few weeks before planting and harvest to allow the field to drain more fully.*  **Figure 3.** *The outlet is raised after planting to potentially store water for crops.* Purdue Extension
Education	Education through ongoing efforts of many entities in the watershed needs to be coordinated and increased. Education through public meetings, BMP demonstrations, literature distribution, news articles, and discussion of existing ordinances will help to increase public awareness of the issues within the watershed. Increased public awareness will help citizens understand the interconnectivity of water quality, the watershed and their everyday lives.
Grade Stabilization	Installation of a structure in a stream that provides a safe means for water to travel from a higher elevation to a lower elevation.  WCC

Grassed Waterways	A grassed waterway is a natural or constructed channel which conveys runoff from concentrated flow areas where erosion control is needed. These waterways are seeded to sod-forming grasses which slow water allowing infiltration and filters out sediment and nutrients.  USDA Natural Resource Conservation Service
Livestock Exclusion Fencing	Fencing can be installed along streams and ditches to keep livestock away from the waterways. This prevents the livestock from trampling and eroding the streambanks or from depositing waste in or near the streams.  USDA Natural Resource Conservation Service
Nutrient Management	Nutrient Management involves analyzing the nutrient content of soil, manure, or fertilizers so the amount, placement, and timing of these nutrients can be managed to obtain optimum crop yields and minimize the impact on water quality.

Residue Management	Reducing tillage, reduces erosion by providing ground cover, improves soil tilth by adding organic matter, reduces evaporation from the soil, and saves time and labor. Reduced tillage is therefore effective in reducing sediment and nutrient loading to streams and ditches. Mulch Till: According to NRCS, Mulch Tillage entails managing crop residue on a year round basis to provide an acceptable erosion rate, conserve moisture, and maintain or improve soil tilth.  WCC No-Till: The NRCS definition for No-Till is managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round. Crops are planted and grown in narrow slots or tilled strips established in the untilled seedbed of the previous crop.  CTIC
Rotational Grazing	Pastures are divided into two or more pastures with fencing. Cattle are rotated between the pastures on a pre-arranged schedule to prevent overgrazing. Overgrazing may leave soil exposed and susceptible to erosion.
Rural Regional Sewer Districts	Installing sewer systems in rural areas would greatly reduce the number of malfunctioning or nonexistent septic systems, therefore significantly decreasing the *E. coli* load from this source.

Sediment Removal	Removing sediment or dredging a waterbody reduces nutrients and other pollutants and restores habitat.
Sediment Trap	A constructed basin designed to capture and retain water, allowing sediment to settle out before water is released.  Historic City of Franklin
Streambank or Shoreline Stabilization	Regrading or vegetating an unstable streambank reduces erosion and therefore sedimentation and may provide wildlife habitat. Any undertaking on a regulated drain or the drain easement will require permit approval from the county surveyors' office and meet the standards and specifications as published by the county surveyors' office. Other state and federal permits may also be required.  WCC  WCC

Wetland Restoration	Wetlands slow water down allowing sediment, nutrients, and other contaminants to settle out. They also act as biological filters, provide wildlife habitat, reduce the risk and damage of flooding by providing overflow storage during storm events, and recharge groundwater. Wetlands have been found beneficial in reducing nutrient and *E. coli* concentrations to flowing streams (DeBusk, 1999).  WCC
Whole Farm Planning	Whole Farm Planning is a holistic approach to farm management which focuses on land stewardship and sustainable practices. These practices include riparian buffers, filter strips, conservation tillage, grassed waterways, livestock exclusion, nutrient management, drainage water management, manure management, rotational grazing, wildlife habitat, contour farming, field borders, windbreaks, crop rotations, cover crops, pest management, and erosion control.

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SECTION 10.0 GOALS AND DECISIONS

Based on the concerns and the problem statements the overall watershed management goal is to improve the water quality and habitat of the UTRLA Watershed by reducing and preventing pollutant loads in the watershed such that, at a minimum, the waterbodies meet Indiana water quality standards. This plan provides specific recommendations for actions (including BMPs) and educational programs to address the water quality issues impacting the UTRLA Watershed. Recommendations for the BMPs came from the UTRLA Steering Committee. The BMPs need to meet the standards and specifications of the USDA, Natural Resource Conservation Service Field Office Technical Guide. The implementation of these BMPs combined with the educational programs and outreach about water quality and land use will lead to lower pollutant loads. Modeled TSS, TN, and TP loads were generated by STEPL for the UTRLA Watershed as if some of the BMPs recommended in this plan had already been implemented. Load reductions were calculated using EPA's Region 5 model. The model provides a uniform system of estimating relative pollutant loads. Phase One of this plan's implementation will last two years. Within that time, efforts will be focused on reaching the target loads by implementing BMPs within the high priority areas for each parameter. If the target is not reached during Phase One, efforts will be redirected to reducing pollutant loads in moderate and low priority areas. The milestones and indicators set in the following sections will be used to indicate if the goals have been met.

10.1 GOALS

The following are the goals listed in their order of importance:

Goal 1: Create a weed management program that balances the needs of multiple lake users.

Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.

Goal 3: Develop sustainable fish populations that support the recreational needs of the lake users.

Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.

Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use (3) Develop sustainable fish populations that support the recreational needs of the lake users.

Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion or other threats.

Goal 7: Provide information and technical education through a wide variety of communication strategies.

Goal 8: Involve government officials in environmental issues and initiatives in the watershed.

10.2 PROPOSED STRATEGIES

Goal 1: Create a weed management program that balances the needs of multiple lake users.

> Problem: Lake residents have concerns about increasing aquatic plant beds within the lakes. Separate strategies have been used to reduce various weeds.
>
> Short-term Target: Identify current plant locations and treatment strategies, identify areas of plant management concern, and review historic data,
>
> Long-term Target: Acquire and disseminate info on successful weed control strategies, identify groups that have alternative views and bring them into the planning process, educate landowners and visitors on values and problems of various weeds, coordinate plant treatment between adjoining lakes, share lessons learned on lake by lake basis.

Phase One for this goal will focus on identifying the aquatic plant locations and who is responsible for treating them. Reviewing historic data, and identifying areas of plant management concern.

Table 97 shows the proposed strategies for reaching the goal.

Table 97. Weed Management Action Register

Objective	Action Items	Cost	Responsible Party	Schedule
Identify current aquatic plants. Review historic data. Identify areas of plant management concern Milestone for this objective is increasing the number of lakes w/Aquatic Veg. Management Plans by 2 per year until all have plans.	Individual lakes apply for Aquatic Vegetation Management Plan funding through IDNR LARE.	$1500 to create and advertise cost share program, $33,640 for cost share	Lake Assoc.	2008
	Hire consultant to complete study once funded.			2008
	Share and compare results with other lake associations.			2009 and beyond
Identify groups with alternative views, bring them into the planning process Milestone for this objective is to identify 1 group per lake.	Develop survey for aquatic plant uses.	$1000 to create and advertise	UTRLA Committee and Sub-committees	2010
	Include survey in newsletters.			2010
	Share information with lake associations.			2010 and beyond
Acquire and disseminate info on successful weed control strategies Milestone for this objective is to provide copies of Aquatic Veg. Plans to other lake assoc. as developed.	Share and compare results with other lake associations.	$100 copying	UTRLA Committee and Sub-committees Lake Assoc.	2010
Educate landowners and visitors on values and problems of various weeds Share lessons learned on a lake by lake basis Milestone for this objective is to develop at least 1 newsletter article per year.	Develop article for aquatic plant uses.	$1000 to create and advertise	UTRLA Committee and Sub-committees	2011
	Include article in newsletters.			2011
	Share information with lake associations.			2011 and beyond
Coordinate plant treatments between lakes	Share planning efforts at monthly meetings.	No cost associated	UTRLA Committee and Sub-committees	2008

Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.

Problem: Although both counties have high numbers for conservation tillage and no-till, there are areas of the watershed in need of conservation practices such as buffers and waterways.

Short-term Target: Engage and utilize SWCD supervisors and staff, coordinate distribution of newsletters, brochures, and websites.

Long-term Target: Create reusable PowerPoint presentations, develop a stable funding source for projects, design and implement nutrient reduction projects, host technical workshops, conduct demonstration site field days or advertise/attend others' events.

Phase One for this goal will focus on the high priority areas, which are subwatershed H (W8), subwatershed F (W6), and subwatershed J (W10), respectively.

Tables 98-100 show the loads and concentrations in the UTRLA Watershed under its current conditions, the target concentration, the load reduction needed in order to reach the target, and the percent reduction needed. Table 101 shows the proposed strategies for reaching the target loads.

Table 98. Load Reductions Needed to Reach TSS Target Concentration

	Concentration	Load
Current	141 mg/L	726 tons/year
Target	80 mg/L	412 tons/year
Reduction Needed	61 mg/L	314 tons/year
Percent Reduction Needed	76%	76%

Table 99. Load Reductions Needed to Reach Total N Target Concentration

	Concentration	Load
Current	1.04 mg/L	10,708 lbs/year
Target	0.75 mg/L	7,722 lbs/year
Reduction Needed	0.29 mg/L	2,986 lbs/year
Percent Reduction Needed	39%	39%

Table 100. Load Reductions Needed to Reach Total P Target Concentration

	Concentration	Load
Current	0.3 mg/L	3,089 lbs/year
Target	0.1mg/L	1,030 lbs/year
Reduction Needed	0.2 mg/L	2,059 lbs/year
Percent Reduction Needed	200%	200%

Table 101. Promote Conservation Practices to Reduce Nutrient Loading Goal Action Register

Objective	Load Reduction	# Needed for Load Reduction	Action Items	Cost	Responsible Party	Schedule
Increase Sediment Traps Milestone for this objective is adding 3 sediment traps within five years.	TSS: 25 t/yr/site	3	Apply fro IDNR LARE funding for Engineering Feasibility Study. Complete Engineering Feas. Study.	$66,000 per sediment trap	ULTRA Committee Consultant	2008 – January 2009
	N: 310 lbs/yr/site		Apply for IDNR LARE funding for Design. Complete Design.			2009 – January 2010
	P: 128 lbs/yr/site		Apply for IDNR LARE funding for Construction. Complete Construction.			2010 – January 2011
			Monitor effectiveness of sediment traps			2011 and beyond
Increase Buffer Strips Milestone for this objective is adding 45 acres of buffers per year for five years (or as needed to reach the goal).	TSS: 0.39 t/ac/yr	225 ac.	Engage and utilize SWCD supervisors and staff.	$150 per ac. Per NRCS FOTG $31,800 Total	ULTRA Committee SWCDs NRCS[1]	Present – Ongoing
	N: 5.4 lbs/ac/yr		Encourage CRP signup.			Present – Ongoing
	P: 3.5 lbs/ac/yr		Determine other sources of funding.			Present – Ongoing
			Monitor buffer effectiveness.			Present – Ongoing
Install Grassed Waterways Milestone for this objective is to increase the number of waterways by 1 ac per year for 5 years (or as needed to reach goal).	TSS: 10 t/ac/yr	5 ac.	Identify areas in need of grassed waterways.	$3420 per acre $85,500 Total	ULTRA Committee SWCDs NRCS[1]	Present – Ongoing
	N: 4.5 lbs/ac/yr		Install grassed waterways.			Present – Ongoing
	P: 2.5 lbs/ac/yr		Monitor grassed waterway effectiveness.			Present – Ongoing
Increase Conservation Tillage and No Till Practices Milestone for this objective is increasing reduced tillage by 150 acres per year for five years (or as needed to reach the goal).	TSS: 0.17 t/ac/yr	750 ac.	Determine other sources of funding.	$8.00-20.00 per acre (NRCS FOTG)	ULTRA Committee SWCDs NRCS[1]	Present – Ongoing
	N: 2 lbs/ac/yr		Determine other sources of equipment modification funding.			Present – Ongoing
	P: 0.25 lbs/ac/yr		Monitor conservation tillage and no till effectiveness.			Present – Ongoing

Table 101 (cont'd). Promote Conservation Practices to Reduce Nutrient Loading Goal Action Register

Stabilize Eroding Areas Milestone for this objective is completing design and construction on 1 identified area every 2 years until completed.	TSS: 0.12 t/ft/yr	200 ft.	Apply fro IDNR LARE funding for Engineering Feasibility Study. Complete Engineering Feasibility Study.	$25,000.00 per location	UTRLA Committee Consultant	2008 – January 2009
	N: 2.3 lbs/ft/yr		Apply for IDNR LARE funding for Design. Complete Design.			2009 – January 2010
	P: 1.2 lbs/ft/yr		Apply for IDNR LARE funding for Construction. Complete Construction.			2010 – January 2011
			Monitor effectiveness.			2011 and beyond
Reduce amount of fertilizer being transported by runoff from urban lawns. Milestone for this objective is increase awareness and reduce excess fertilizer use.	3	N/A	Promote minimal fertilizer use through education programs.	$1000 to create and advertise	UTRLA Committee Property Owners	Present – On-going
			Monitor effectiveness.			Present – On-going
Nutrient Management Planning Milestone for this objective is implementing nutrient management planning on 75 acres per year for five years while maintaining soil productivity.	TSS: N/A	375 ac.	Promote and implement nutrient management planning.	$20 per acre	ULTRA Committee SWCDs NRCS[1]	Present – On-going
	N: 2.0 lbs/ac/yr					
	P: 0.25 lbs/ac/yr		Monitor effectiveness.			Present – Ongoing
Reduce N Loads from Tile Drains Milestone for this objective is installing 2 drainage water control structures per year for five years.	TSS: N/A	10 structures	Determine funding sources for drainage water control structures.	$700-2,200 per structure[2]	ULTRA Committee SWCDs NRCS[1]	Present – On-going
	N: 122 lbs/ structure/yr					
	P: not determined		Install drainage water control structures.			Present – On-going
Wetland restoration Milestone for this objective is to identify potential areas, and restore 1 acre of wetlands per year for 5 years.	3	N/A	Identify potential wetland restoration sites.	$10,000-25,000 per acre depending on site	ULTRA Committee SWCDs NRCS[1]	Present – On-going
			Restore wetlands.			Present – On-going
			Monitor wetland effectiveness.			Present – On-going

[1] NRCS is included in this column only as a means to give credit for the USDA program work they are doing that may result in the installation of BMPs in the UTRLA Watershed it is not meant to add additional workload.
[2] Purdue Extension *Drainage Water Management for the Midwest* WQ-4
[3] Load reductions will be calculated on an individual basis due to the parameter variances.

Goal 3: Develop sustainable fish populations that support the recreational needs of lake users.

Problem: Improve declining fish populations and species combinations.

Mid-term Target: ID and understand current and past condition of fish populations, share fishery info in public-friendly way, explore the use of artificial fish habitat or other habitat improvement projects.

Long-Term Target: Learn about stocking programs, ID differences in fishery expectation of residents and non-residents, ID who fishes the lakes and what they are catching (spend time on ramps, resident surveys, creel info from DNR).

Table 102 shows the proposed strategies for reaching the goal.

Table 102. Sustainable Fish Populations Goal Action Register

Objective	Action Items	Cost	Responsible Party	Schedule
ID and understand current and past condition of fish populations. Explore the use of artificial fish habitat or other habitat improvement projects. Share fishery info in public-friendly way Milestone for this objective is to obtain funding and complete study by 2011.	Determine funding sources, apply for funding.	$15,000	ULTRA Committee Consultant	2010 – 2011
	Hire consultant to complete study.			2011
	Share information.			2011 and beyond
Learn about stocking programs Milestone for this objective is obtain information by 2012.	Obtain information from IDNR Fisheries Biologist.	$100 Copying costs	ULTRA Sub Committee	2012
	Share information.			2012
				2012 and beyond
ID differences in fishery expectation of residents and non-residents ID who fishes the lakes and what they are catching (spend time on ramps, resident surveys, creel info from DNR) Milestone for this objective is to develop survey, distribute in newsletters and while conducting fish ID.	Develop survey for fishermen.	$1000 to create and advertise	ULTRA Sub Committee	2012
	Include survey in newsletters.			2012
	Share information with lake associations.			2012 and beyond

Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.

Problem: Resident within the watershed may not be aware of development and agricultural practices within the watershed and the subsequent impacts.

Short-term Target: Build relationships with county officials, participate in county comprehensive planning process, Conduct surveys to determine interest and needs for certain topics.

Long-term Target: Help develop a new erosion control ordinance for all land disturbing activities, provide experts to come talk to general public and lake residents on specific topics, conduct a workshop with hands-on water quality modules, create a brochure on agricultural statistics and practices aimed at lake residents/lay people.

Table 103 shows the proposed strategies for reaching the goal.

Table 103. Impacts of Development and Agricultural Practices Goal Action Register

Objective	Action Items	Cost	Responsible Party	Schedule
Build relationships with county officials Participate in county comprehensive planning process Milestone for this objective is increasing awareness by educating 2 officials in each county.	Attend meetings.	Cost built into sediment cost est.	ULTRA Committee Individuals	2008 – 2009
	Personal communication with officials.			2008 – 2009
	Become familiar with comprehensive planning process.			2008 – 2009
Conduct surveys to determine interest and needs for certain topics Milestone for this objective is to develop survey and distribute in newsletters.	Develop survey for educational needs.	$1000 to create and advertise	ULTRA Sub Committee	2010 – 2011
	Include survey in newsletters.			2011
	Share information with lake associations.			2011 and beyond
Help develop a new erosion control ordinance for all land disturbing activities Milestone for this objective is to complete ordinance by 2012.	Determine funding sources, apply for funding.	$8000	ULTRA Sub Committee Consultant	2011 – 2012
	Hire consultant to complete ordinance.			2012
	Share information.			2012 and beyond
Provide experts to present to general public and lake residents on specific topics Conduct a workshop with hands-on water quality modules Create a brochure on agricultural statistics and practices aimed at lake residents/lay people Milestone for this objective is to obtain funding and complete study by 2012.	Determine funding sources, apply for funding.	$7000	ULTRA Sub Committee Consultant	2011 – 2012
	Hire consultant to complete workshop and brochure.			2012
	Share information.			2012 and beyond

Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use.

Problem: Funneling—also known as “keyhole development”—is the use of a single waterfront lot by multiple users. Through this type of development, direct lake access is made possible to non-adjacent lake users. Funneling allows access to numerous users of a lot designed for a single household.

Short-term Target: Raise awareness of County officials (particularly Noble Co.) to needs of the lakes (using Kosciusko and Whitley ordinances as examples), create exchange of info with DNR regarding options for seawalls, erosion control, etc., Contact Conservation Officers for better enforcement of recreational violations (boating, piers, etc.), Educate area Plan Commissions and Zoning Boards.

Long-term Target: Contact realtors and developers about ecological impacts and property values.

Table 104 shows the proposed strategies for reaching the goal.

Table 104. Funneling Ordinance Goal Action Register

Objective	Action Items	Cost	Responsible Party	Schedule
Raise awareness of County officials (particularly Noble Co.) to needs of the lakes (using Kosciusko and Whitley ordinances as examples) Milestone for this objective is ordinance creation in Noble County.	Attend meetings.	Volunteer hours by individuals	ULTRA Committee Individuals	2007
	Personal communication with officials.			2007
	Official ordinance passed.			2007
Create exchange of info with DNR regarding options for seawalls, erosion control, etc. Milestone for this objective is to increase information exchange.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2009 – On-going
	Share information with lake associations.			2009 and beyond
Contact Conservation Officers for better enforcement of recreational violations (boating, piers, etc.) Milestone for this objective is increased patrols on lakes.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2009
Educate area Plan Commissions and Zoning Boards Milestone for this objective is increasing awareness by educating 1 official in each county.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2009
Contact realtors and developers about ecological impacts and property values Milestone for this objective is increasing awareness by educating 1 realtor in each county.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2009

Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion and other threats.

Problem: Eroding areas along shorelines, ditches, and natural areas increase sediment and nutrients into the water bodies.

Short-term Target: ID all ditches, inlets, outlets, and natural area on master map, determine where the legal shorelines are located, determine what the current legal restrictions are for shorelines and wetlands and who regulated them, and determine locations of shoreline erosion and methods to prevent erosion.

Long-term Target: Encourage enforcement of shoreline and wetland restrictions (use local venues), better understand funding for ditch maintenance and maintenance process for ditches, determine locations of shoreline erosion and methods to prevent erosion

Table 105 shows the proposed strategies for reaching the goal.

Table 105. Protect Natural Shorelines Goal Action Register

Objective	Action Items	Cost	Responsible Party	Schedule
ID all ditches, inlets, outlets, and natural area on master map. Determine where the legal shorelines are located. Determine what the current legal restrictions are for shorelines and wetlands and who regulates them. Determine locations of shoreline erosion and methods to prevent erosion Milestone for this objective is to protect areas of eroding shorelines.	Determine funding sources, apply for funding.	$8000	ULTRA Committee Consultant	2010 - 2011
	Hire consultant to complete study.			2011
	Share information.			2011 and beyond
Encourage enforcement of shoreline and wetland restrictions (use local venues) Milestone for this objective is to increase information exchange.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2012 – On-going
	Share information with lake associations.			2012 and beyond
Better understand funding for ditch maintenance and maintenance process for ditches. Increase funding for ditch maintenance and protection projects Milestone for this objective is increased funding for ditch maintenance.	Personal communication with officials.	Volunteer hours by individuals	ULTRA Sub Committee	2012

Goal 7: Provide information and technical education through a wide variety of communication strategies.

Problem: An adequate informational and educational program is not in place in the UTRLA Watershed to inform residents of their role in the overall water quality of the watershed.

Short-term Target: Get schedule of each lake's annual meeting and other organizations' meetings and plan talks at each, invite media to meetings, provide articles for watershed newsletters and websites, develop informational pamphlets, utilize boat ramps (host events at ramp, use kiosks, have messages or survey boxes).

Long-term Target: Host topical workshops, develop fundraising events for education programs, and develop ways to reach kids in schools or 4H.

Table 106 shows the proposed strategies for reaching the goal.

Table 106. Informational and Educational Goal Action Register

Objective	Action Items	Target Audience	Cost	Responsible Party	Schedule
Get schedule of each lake's annual meeting and other organizations' meetings and plan talks at each.	Media Campaign.	Property Owners	$1,000 per year	UTRLA Committee	2008
Invite media to meetings.	Media Campaign.	Urban Landowners	N/A	UTRLA Committee	2008 and beyond
Provide articles for watershed newsletters and websites.	Media Campaign.	All Landowners	$500 per year	UTRLA Committee Sub Committee	2009
Develop informational pamphlets.	Media Campaign.	All Landowners	$1,250 per year	UTRLA Committee	2009
Utilize boat ramps (host events at ramp, use kiosks, have messages or survey boxes).	Media Campaign.	Lake Users	$200 per event	UTRLA Committee	2010
Host topical workshops.	Media Campaign.	All Landowners	$4000	UTRLA Committee Consultant	2012
Develop fundraising events for education programs.	Media Campaign.	All Landowners	N/A	UTRLA Committee	2012
Develop ways to reach kids in schools or 4H.	Media Campaign.	Future Landowners	N/A	UTRLA Committee	2012

Goal 8: Involve government officials in environmental issues and initiatives in the watershed.

Problem: Officials are unaware of environmental issues and activities in the watershed and their decisions may be based on this lack of awareness.

Short-term Target: Develop list of key players and contact info, invite county officials to UTRLA meetings, email officials regular updates, form sub committees and ID individual responsible for contacting law makers and media, craft standard messages for all members to deliver, invite legislators to events, send UTRLA products to officials.

Long-term Target: Set one-on-one meetings with law makers in the off-season, Host Congressional field day.

Table 107 shows the proposed strategies for reaching the goal.

Table 107. Involve Elected Officials Goal Action Register

Objective	Action Items	Target Audience	Cost	Responsible Party	Schedule
Develop list of key players and contact info.	Committee Activity.	Committee	Volunteer hours by individuals	UTRLA Committee	2008 - 2009
Invite county officials to UTRLA meetings.	Personal Contact.	Elected Officials	Volunteer hours by individuals	UTRLA Committee	2008 - 2009
Email officials regular updates.	Personal Contact.	Elected Officials	Volunteer hours by individuals	UTRLA Committee Sub Committee	2008 - 2009
Form sub committees and ID individual responsible for contacting law makers and media.	Committee Organization.	Committee	N/A	UTRLA Committee	2010 - 2011
Craft standard messages for all members to deliver.	Media Campaign.	Elected Officials	Volunteer hours by individuals	UTRLA Committee	2010 - 2011
Invite legislators to events.	Personal Contact.	Elected Officials	Volunteer hours by individuals	UTRLA Committee	2010 - 2011
Send UTRLA products to officials.	Media Campaign.	Elected Officials	Varies by lake.	UTRLA Committee	2010 - 2011
Set one-on-one meetings with law makers in the off-season.	Personal Contact.	Elected Officials	Volunteer hours by individuals	UTRLA Committee	2012
Host Congressional field day.	Media Campaign.	Elected Officials	$1000	UTRLA Committee	2012

10.3 LOAD REDUCTIONS BASED ON STRATEGIES

Based on the strategies listed in Goal 2 the following load reductions were estimated using the IDEM/EPA Region 5 Pollution Load Reduction Model. The load reduction results based on Table 101 appear in Table 108.

Table 108. Long Range Estimated Load Reductions Based on Goal 2 Strategies

Year	Sediment Reduction Tons	Nitrogen Reduction LBS	Phosphorus Reduction LBS
2015	1,521	23,315	8,403
2020	6,842	104,918	37,811
2025	15,965	244,807	88,226

Once implemented, this watershed management plan will exceed the goals for total suspended solids, nitrogen, and phosphorus reductions by the year 2015.

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SECTION 11.0 MEASURING PROGRESS

The overall success of the plan is dependent upon implementation of action items for improving water quality to water quality standards. The implementation of the UTRLA Watershed Management Plan will be tracked through a system of administrative, social, and environmental indicators. For example, environmental indicators will include the acres of conservation tillage and no-till implemented and the length of buffers installed; and administrative indicators will be the number and type of best management practices (BMPs) implemented once the implementation phase is underway. The UTRLA Watershed steering committee intends to develop a water quality monitoring plan in order to measure progress throughout the watershed. Future water quality monitoring results will help document the impact of implementation projects. Social or behavioral indicators will focus on documenting involvement, such as the number of property owner responses, the number of volunteer hours logged, the number of stakeholders recruited and involved in the Steering Committee and public meetings, the number of partners providing project support, and the amount of match funds received. Community indicators of social change such as public policy/ordinance will also be used.

11.1 PROGRESS INDICATORS

The following section describes concrete milestones for stakeholders to reach and tangible deliverables produced while they work toward each goal. All of the goals include long-term goals (i.e. it will take more than 4 years to attain).

Goal 1: Create a weed management program that balances the needs of multiple lake users.

Indicators: (Except for annual or continuous tasks, this goal should be reached by 2012.)

- Number of lakes with Aquatic Vegetation Management Plans
- Identify one group per lake with alternative views for aquatic vegetation
- Develop at least one news article on aquatic vegetation per year

Goal attainment: The goal is attained when a weed management program is in place.

Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.

Indicators: (Except for continuous or annual tasks. The goal should be reached by 2020.)

- Number of sediment traps installed
- Number and length of buffers installed
- Number of grassed waterways installed
- Number of acres of conservation tillage implemented.
- Number of acres of no-till implemented
- Number of grade stabilization practices installed
- Survey amount of fertilizer used in residential areas
- Creation of a database for other funding sources
- Numbers of acres of nutrient management
- Number of tile drainage control structures
- Number of restored wetlands

Goal attainment: The goal is attained when Best Management Practices are implemented to reduce loads to target levels.

Goal 3: Develop sustainable fish populations that support the recreational needs of the lake users.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2012.)

- Completed fish population study
- Obtain fish stocking information
- Survey fishermen

Goal attainment: The goal is attained when the fish population in the seven lakes has reached healthy fishable levels for desired species.

Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2012.)

- Increase watershed awareness for 2 elected officials per county
- One UTRLA person per county participate in comprehensive planning
- Create ordinance for land disturbing activities
- Create brochure
- Conduct a water quality workshop

Goal attainment: The goal is attained when an educational program is in place dealing with development and agricultural practices.

Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2009.)

- Ordinance created in Noble County
- Sharing of information with DNR
- Increased lake patrols
- Increase lakeshore development awareness with 1 planning official per county
- Increase ecological impacts awareness with one realtor per county

Goal Attainment: This goal is attained when the ordinance to prevent funneling is in place.

Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion and other threats.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2012.)

- Amount of shoreline erosion corrected
- Creation of master drainage map
- Identify legal shorelines
- Increase in funding for ditch maintenance

Goal attainment: The goal is attained when shorelines, ditches, and natural areas are restored to their natural conditions.

Goal 7: Provide information and technical education through a wide variety of communication strategies.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2012.)

- Number of annual meetings attended
- Number of meetings attended by media
- Number of articles for newsletters
- Number of brochures created
- Number of workshops
- Number of fundraising events

Goal attainment: The goal is attained when a water quality education program is in place.

Goal 8: Involve government officials in environmental issues and initiatives in the watershed.

Indicators: (Except for annual/continuous tasks, milestones should be reached by the end of 2012.)

- Number of county officials attending UTRLA meetings
- Number of updates emailed to officials
- Number of legislators at events
- Number of one on one meetings with lawmakers
- Conduct Congressional field day

Goal attainment: The goal is attained when elected officials are educated about issues and involved in the watershed.

11.2 MONITORING PROGRESS

Monitoring is an important component of this watershed management plan. Without monitoring, stakeholders will not know when or whether they have achieved their goals; or worse, they will not make timely refinements to their actions to ensure the actions they are taking will achieve their goals. The previous section details how stakeholders will monitor their progress toward achieving the goals set in this watershed management plan.

11.3 PLAN REVISIONS

This watershed management plan is meant to be a living document. Revisions and updates to the plan will be necessary as stakeholders begin to implement the plan and as other stakeholders become more active in implementing the plan.

SECTION 12.0 IMPLEMENTATION

The Upper Tippecanoe River and Lake Association Steering Committee will be the lead entity promoting the implementation of the UTRLA Watershed Management Plan. Expanding upon the partnerships developed during the plan development phase, the UTRLA Steering Committee will solicit additional partners to support the watershed management plan. The steering committee will coordinate any future funding efforts, implementation, and evaluation of the UTRLA Watershed Management Plan. Annual updates will be completed at steering committee meetings and communicated through the lake association newsletters.

SECTION 13.0 REFERENCES

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Appendix A

UTRLA Seven Lakes Watershed Partners List

WATERSHED PARTERS/STAKEHOLDERS

A. State and Federal Agency Stakeholders

Indiana Department of Natural Resources (IDNR)
402 W. Washington Street
Indianapolis, IN 46204-2748

Division of Nature Preserves
Room W267
317-232-4052

Division of Fish & Wildlife
Room W273
317-232-4080

Division of Entomology & Plant Pathology
Room W290
317-232-4120

Division of Forestry
Room W296
317-232-4105

Division of Water
Room W264
317-232-4160

Division of Outdoor Recreation
Room W271
317-232-4070

Indiana Department of Environmental Management (IDEM)
100 N. Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206-6015
317-233-8491
800-451-6027

Natural Resources Conservation Service (NRCS)
6013 Lakeside Boulevard
Indianapolis, IN 46278
317-290-3200

Farm Service Agency (FSA)
5981 Lakeside Boulevard
Indianapolis, IN 46278
317-290-3030

U.S. Army Corps of Engineers (USACE)
Louisville District
P.O. Box 59
Louisville, KY 40201-0059
502-582-5607

U.S. Environmental Protection Agency (USEPA)
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590
800-632-8431

U.S. Fish & Wildlife Service (USFWS)
620 S. Walker Street
Bloomington, IN 47403-2121
812-334-4261

Indiana Association of Soil & Water Conservation Districts (IASWCD)
225 S. East Street, Suite 740
Indianapolis, IN 46202

Indiana Department of Transportation (INDOT)
100 N. Senate Avenue, Room N808
Indianapolis, IN 46204
317-232-5468

Indiana Chamber of Commerce
115 W. Washington Street #850 S.
Indianapolis, IN 46204
317-264-6881

Indiana State Department of Health
2 N. Meridian Street
Indianapolis, IN 46204
317-233-1325
Contact person: Gregory Wilson

Indiana Association of County Commissioners
County Office Building
20 N. 3rd Street
Lafayette, IN 47901-1214
765-423-9215
Contact person: Ruth Shedd

Indiana Association of Cities and Towns
150 W. Market Street, Suite 728
Indianapolis, IN 46204
317-237-6200
Contact person: Tonya Galbraith

Indiana Farm Bureau, Inc.
225 S. East Street
Indianapolis, IN 46202
317-692-7851

U.S. Senator Richard Lugar
(senator_lugar@lugar.senate.gov)
Federal Building Room 3158
1300 S. Harrison Street
Fort Wayne, IN 46802
260-422-1505

U.S. Senator Evan Bayh
(senator@bayh.senate.gov)
10 W. Market Street, Suite 1650
Indianapolis, IN 46204
317-554-0750

U.S. Representative Mark Souder
3105 Federal Building
1300 Harrison Street
Fort Wayne, IN 46802
260-424-3041

B. <u>Local Offices of State & Federal Agency Stakeholders</u>

Indiana Department of Environmental Management (IDEM)
220 W. Colfax Avenue
South Bend, IN 46601-1634
800-753-5519

Natural Resources Conservation Service (USDA)

Kosciusko County
Contact Person: Sam St. Clair
217 E. Bell Drive
Warsaw, IN 46580
574-267-5726

Whitley County
Contact Person: Amy Lybarger
1911 E. Business 30
Columbia City, IN 46725
260-244-6780

Noble County
Contact Person: Wayne Stanger
100 E. Park Drive
Albion, IN 46701
260-636-7682

Farm Service Agency (USDA)

Kosciusko County
Contact Person: Leila Knoblock
217 E. Bell Drive
Warsaw, IN 46580
574-267-7445

Whitley County
Contact Person: Eric Mason
1911 E. Business 30
Columbia City, IN 46725
260-244-6780

Noble County
Contact Person: Karl Clark
100 E. Park Drive
Albion, IN 46701
260-636-7682

Rural Development (USDA)

ISTA Center, Suite 414
150 W. Market Street
Indianapolis, IN 46204
317-232-8776
Contact Persons:
Mary Henry 260-636-7682
Melissa Christiansen 574-936-9872
Enzley Mitchell III 260-248-8924

Indiana Department of Natural Resources (IDNR)

Division of Fish & Wildlife
Contact Person: Randy Millar, Property Manager
Tri-County FWA
8432 N. 850 E.
Syracuse, IN 46567
574-834-4461

Division of Fish & Wildlife
Contact Person: Jed Pearson, Fisheries Biologist/Ed Braun, Fisheries Biologist
Tri-Lakes Fisheries Station
5570 N. Fish Hatchery Road
Columbia City, IN 46725

Soil & Water Conservation District

Whitley County
Contact Person: Nadean Eldien
1919 E. Business 30
Columbia City, IN 46725
219-244-6266

Noble County
Contact Person: Stacey McGinnis
100 E. Park Drive
Albion, IN 46701
260-636-7682

C. <u>State Government Stakeholders</u>

Senator Gary Dillon (s17@ai.org)
331 N. Chauncey Street
Columbia City, IN 46725
260-436-8000

Senator Robert Meeks (s13@ai.org)
5840 E. 25 N.
LaGrange, IN 46761
260-463-3198

Representative Dan Leonard (r50@ai.org)
6274 N. Goshen Rd.
Huntington, IN 46750
260 356-5122

Representative Matt Bell (r83@ai.org)
200 W. Washington St.
Indianapolis, IN 46204
800-382-9841

D. <u>County Government Stakeholders</u>

Whitley County Commissioners
101 W. Van Buren Street
Columbia City, IN 46725
260-248-3100
Contact Persons: James Pettigrew, Thomas Rethlake, Michael Schrader

Whitley County Council
101 W. Van Buren Street
Columbia City, IN 46725
260-248-3100
Contact Persons: James Bayman, James Barrett, Scott Darley, Glen LaRue, William Overdeer, Kim Wheeler

Whitley County Surveyor
101 W. Van Buren Street
Columbia City, IN 46725
260-248-3185
Contact Person: Brandon Forrester

Whitley County Highway Department
801 S. Line Street
Columbia City, IN 46725
260-248-3123
Contact Person: Randy Knach

Whitley County Health Department
101 W. Market Street, Suite A
Columbia City, IN 46725
260-248-3121
Contact Person: Scott Wagner

Whitley County Area Planning Department
101 W. Market Street, Suite B
Columbia City, IN 46725
260-248-3112
Contact Person: David Sewell

Whitley County Extension Service
115 S. Line Street
Columbia City, IN 46725
260-244-7615
Contact Person: Valynnda Slack

Whitley County Building Inspector
101 W. Market Street, Suite B
Columbia City, IN 46725
260-248-3112
Contact Person: Craig Wagner

Noble County Commissioners
101 N. Orange Street
Albion, IN 46701
(260) 636-7877
Contact Persons: Mark Pankop, Jack Herendeen, J. Hal Stump

Noble County Council
101 N. Orange Street
Albion, IN 46701
260-636-7877
Contact Persons: Harold Troyer, Randy Myers, Judy Haas, Don Moore, Les Alligood, Joy LeCount, Thomas Janes

Noble County Building Inspector
2090 S. State Road 9
Albion, IN 46701
260-636-2215
Contact Person: Richard Adair

Noble County Highway Department
1118 E. Main Street
Albion, IN 46701
260-636-2124
Contact Person: Keith Lytton

Noble County Health Department
2090 S. State Road 9, Suite C
Albion, IN 46701
260-636-2191
Contact Persons: Dr. Gerald Warrener-Health Officer/Jack Chronsiter-Septic Health Inspector

Noble County Area Planning Department
2090 S. State Road 9, Suite A
Albion, IN 46701
260-636-7217
Contact Person: Steve Kirkpatrick

Noble County Solid Waste District
2320 W. 800 N.
Ashley, IN 46705
260-587-3063
Contact Person: Steve Christman

Noble County Surveyor
2090 S. State Road 9, Suite B
Albion, IN 46701
260-636-2131
Contact Person: Scott Zeigler

Noble County Extension Service
2090 S. State Road 9, Suite D
Albion, IN 46701
260-636-2111
Contact Person: Beth Green
(beth.green@ces.purdue.edu)

E. Upper Tippecanoe Watershed Stakeholders

Acres Land Trust
200 N. Wells Street
Fort Wayne, IN 46808
219-422-1004
Contact Person: Carolyn McNagny

American Fisheries Society
P.O. Box 100
Seymour, IN 47274
Contact Person: Scott Shuler

Big Lake Association
3994 W. Lake Shore Drive
Columbia City, IN 46725
260-691-2044
Contact Person: Mike Martin
(mdmart@netusa1.net)

Crooked Lake Property Owners Association Inc.
465 E. Morsches Road
Columbia City, IN 46725
260-691-3577
Contact Person: Jan Barkley

Ducks Unlimited
6425 Oak Mill Place
Fort Wayne, IN 46835
260-486-2505
Contact Person: Clark Milestone

Ducks Unlimited
15784 Menominee
Plymouth, IN 46563
219-936-2405
Contact Person: Terry Jolly

Goose Lake Association
3445 W. Shoreline Drive
Columbia City, IN 46725
260-248-2508
Contact Person: Denise Heckman

Hoosier Audubon Council
6530 W. Wallen Road
Fort Wayne, IN 46818
260-489-5032
Contact Person: Paul McAfee

Hoosier Bass ‘N Gals
600 Gentry
Frankfort, IN 46041
Contact Person: Linda Personette

Hoosier Environmental Council
520 E. 12th Street, Suite 14
P.O. Box 1145
Indianapolis, IN 46206-1145
317-685-8800
Contact Person: Tim Maloney

Hoosier Muskie Hunters
Webster Lake Musky Club No. 49
P.O. Box 670
North Webster, IN 46555
574-834-1669
Contact Person: Chae Dolsen

Indiana Audubon Society
Richardson Wildlife Sanctuary
64 West Road-Dune Acres
Chesterton, IN 46304
219-787-8983
Contact Person: John Thiele

Indiana Beef Cattle Association
8770 Guion Road, Suite A
Indianapolis, IN 46268
317-872-2333
Contact Person: Phillip Anderson
(pgaibca@iquest.net)

Indiana Chapter B.A.S.S. Federation
6911 Caledonia Circle
Indianapolis, IN 46254
Contact: Steve Cox

Indiana Corn Growers Association
225 S. East Street, Suite 737
Indianapolis, IN 46202
317-692-7151
Contact Person: Michael Aylesworth

Indiana Farm Bureau
225 S. East Street
Indianapolis, IN 46202
800-866-1160
Contact Persons :
Susan Lawrence (260-349-0402)
John Newsom (260-276-5378)
Brian Daggy (317692-7835)

Indiana Farmers Union, Inc.
3901 W. 86th Street
Indianapolis, IN 46268
Contact Person: Lawrence Dorrell

Indiana Forestry & Woodland Owners Association
Board of Directors
5578 S. 500 W.
Atlanta, IN 46031

Indiana Geological Survey
611 N. Walnut Grove
Bloomington, IN 47405-2208
812-855-7636
(igsinfo@indiana.edu)

Indiana Grain & Feed Association Inc.
Consolidated Grain & Barge
Box 547, Bluff Road
Mt. Vernon, IN 47620
800-669-0085
Contact Person: Don Smolek
(smolekd@cgb.com)

Indiana Hardwood Lumbermen's Association
3600 Woodview Trace, Suite 305
Indianapolis, IN 46268
317-875-3660
Contact Person: Vicki Carson

Indiana Lakes Management Society
207 S. Wayne, Suite B
Angola, IN 46703
574-842-3686
Contact Person: Ron Bedwell

Indiana Plant Food & Agicultural Chemicals Association Inc.
Garrett Fertilizer
1622 County Road 52
Garrett, IN 46738
260-357-5432
Contact Person: Curt Custer
(custergrain@fwi.com)

Indiana Pork Producers Association
8902 Vincennes Circle, Suite F
Indianapolis, IN 46268
Contact Person: Terry Fleck

Indiana Rural Water Association
P.O. Box 679
Nashville, IN 47448
Contact Person: Marilyn Gambold

Indiana Seed Trade Association
Holdens Foundation Seeds LLC
RR1, Box 149
Franklin, IN 46131
317-535-8357
Contact Person: Scott Williams
(scott.Williams@holden.com)

Indiana Soybean Growers Association
423 W. South Street
Lebanon, IN 46052
Contact Person: Anita Stuever

Indiana Sportsman's Roundtable
500 Tamarack Lane
Noblesville, IN 46060
317-773-2944/317-575-4555
Contact Person: Bob Gerdenich II

Indiana State Dairy Association
208 Poultry Science Building
West Lafayette, IN 47907-1016
Contact Person: Robert Jones

Indiana State Poultry Association Inc.
Hy-Line International
1029 Mill Site Drive
Warren, IN 46792
Contact Person: Curt Schmidt

Izaak Walton League
2173 Pennsylvania Street
Portage, IN 46368-2448
219-762-4876
Contact Person: Charles Siar

Indiana Wildlife Federation
50 Rangeline Road, Suite A
Carmel, IN 46032
317-571-1220
Contact Person: Charlie O'Neill

Loon Lake Property Owners Association
7543 N. Maple Lane
Columbia City, IN 46725
Contact Person: Don Davis

National Wild Turkey Federation
8818 N. 400 W.
Roann, IN 46974
765-982-7935
Contact Person: Randy Showalter

Nature Conservancy-Tippecanoe Project
P.O. Box 69
Winamac, IN
574-946-7491
Contact Person: Chad Watts (cwatts@tnc.org)

New Lake Property Owners
6730 N 350 W
Columbia City, IN 46725
Contact Person: Dan Platter

North American Lakes Management Society
P.O. Box 5443
Madison, WI 53705-5443
608-233-2386

Northwest Indiana Steelheaders, Inc.
P.O. Box 701
Chesterton, IN 46304
Contact Person: Mike & Janet Ryan

Old Lake Property Owners
7551 N Brown Rd.
Columbia City, IN 46725
Contacts: Jane Loomis & Jeanne Rethlake

Pheasants Forever
420 Dawn Avenue
Danville, IL 61832
217-446-2958
Contact Person: Tom Kieschenmann

Pheasants Forever
3806 N. 925 E.
Pierceton, IN 46562
574-834-2283
Contact Person: Rich Wells

Purdue University Cooperative Extension Service
Agronomy 1150 Lilly Hall
Purdue University
West Lafayette, IN 47997
765-494-6134
Contact Person: John Peverly
(jpeverly@purdue.edu)

Quail Unlimited
Route 4, Box 152
Vincennes, IN 47592
812-886-6436
Contact Person: Ray McCormick

Sierra Club
212 W. 10th Street, Suite A-335
Indianapolis, IN 46202
317-972-1903
Contact Person: Susan Thomas

Tri-Lakes Regional Sewer District
5240 N. Old 102
Columbia City, IN 46725
260-691-2820

Waterfowl USA
1707 South Cline Avenue
Griffith, IN 46319
765-322-1545
Contact Person: Don Roberts

Whitley County Economic Development Corporation
561 North Line Street, Suite F
Columbia City, Indiana 46725
260-244-5506
Contact Person: Dorinda Heiden
(www.whitleybiz.com)

Wood-Land-Lakes RC & D
214 W. North Street
Kendallville, IN 46755-1134
260-349-1433
Contact Person: Kathy Latz (woodland-lakes@in.rcdnet.org

F. Media Stakeholders

Chronicle Tribune
610 S. Adams Street
Marion, IN 46952
765-664-5111

Elkhart Truth
103 S. 3rd Street
Goshen, IN 46526
574-533-8676

Fort Wayne Newspapers Inc.
600 W. Main Street
Fort Wayne, IN 46802
219-461-8516

Journal Gazette
215 E. Van Buren Street #204
Columbia City, IN 46725
260-244-3944

Journal-Gazette Bureau
3755 Lake City Highway, #9
Warsaw, IN 46580

Mail Journal
103 E. Main Street
Syracuse, IN 46567
574-457-3666

Post & Mail
927 W. Connexion Way
Columbia City, IN 46725
260-244-5153

Senior Life
206 S. Main St.
Milford, IN 46542

South Bend Tribune
122 W. Washington Street
Elkhart, IN 46516
800-220-7378

Sun & Evening Star
P.O. Box 39
Kendallville, IN 46755
260-347-0400

WNIT-Public Television
P.O. Box 3434
Elkhart, IN 46515-3434

Appendix B

UTRLA Seven Lakes
Public Meeting Information

What's going on around you?

Do you have Shoreline erosion?

Weed problems?

Poor water quality?

Blue gill too small?

WE WANT YOUR INPUT!!!

Williams Creek will be sharing plans for a diagnostic study/strategic management plan.

Join us for this important meeting!

Big Lake Church of God, St. Rd. 109

Tuesday, December 12, 2006 ~ 6:30p.m.

~ Info and Refreshments

Upper Tippecanoe River Lake Association (UTRLA)

• BIG LAKE • CRANE LAKE •

• NEW LAKE • OLD LAKE •

CROOKED LAKE • GOOSE LAKE • LOON LAKE

VERY IMPORTANT FINAL MEETING

To review results of the

DIAGNOSTIC STUDY/STRATEGIC MANAGEMENT PLAN for

• BIG LAKE • CRANE LAKE • CROOKED LAKE
• GOOSE LAKE • LOON LAKE • NEW LAKE • OLD LAKE

JOIN YOUR NEIGHBORS AT

Big Lake Church of God, St. Rd. 109

Thursday, December 13, 2007 ~ 6:30 p.m.

Sponsored by: **Upper Tippecanoe River Lake Association (UTRLA)** *and* Tippecanoe Environmental Lake & Watershed Foundation

VERY IMPORTANT FINAL MEETING

To review results of the

DIAGNOSTIC STUDY/STRATEGIC MANAGEMENT PLAN for

• BIG LAKE • CRANE LAKE • CROOKED LAKE
• GOOSE LAKE • LOON LAKE • NEW LAKE • OLD LAKE

JOIN YOUR NEIGHBORS AT

Big Lake Church of God, St. Rd. 109

Thursday, December 13, 2007 ~ 6:30 p.m.

Sponsored by: **Upper Tippecanoe River Lake Association (UTRLA)** *and* Tippecanoe Environmental Lake & Watershed Foundation

Wondering about what's happening with fishing on our lakes?

JOIN YOUR NEIGHBORS FROM

• BIG LAKE • CRANE LAKE • CROOKED LAKE • GOOSE LAKE • LOON LAKE • NEW LAKE • OLD LAKE

as we discuss with the DNR and a panel of experts the direction our Diagnostic Study is taking.

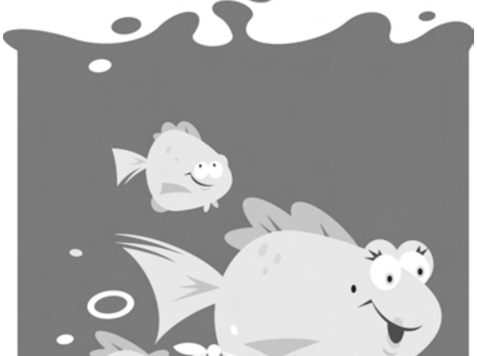
Big Lake Church of God, St. Rd. 109

Thursday, July 12, 2007 ~ 6:30 p.m.

Join us for this important meeting! Refreshments served!

Learn more about beautification of our lakes

WEEDS DRAGGING YOU DOWN?



Then...join us on

Thursday, August 9th

6:30 p.m. Big Lake Church of God

Mid Point Reporting

on our Diagnostic Study ~ focused on water quality

Sponsored by

Upper Tippecanoe River Lake Association (UTRLA)

Appendix C

UTRLA Seven Lakes
Water Quality Report
and
Data Sheets
by
Commonwealth
Biomonitoring

Introduction

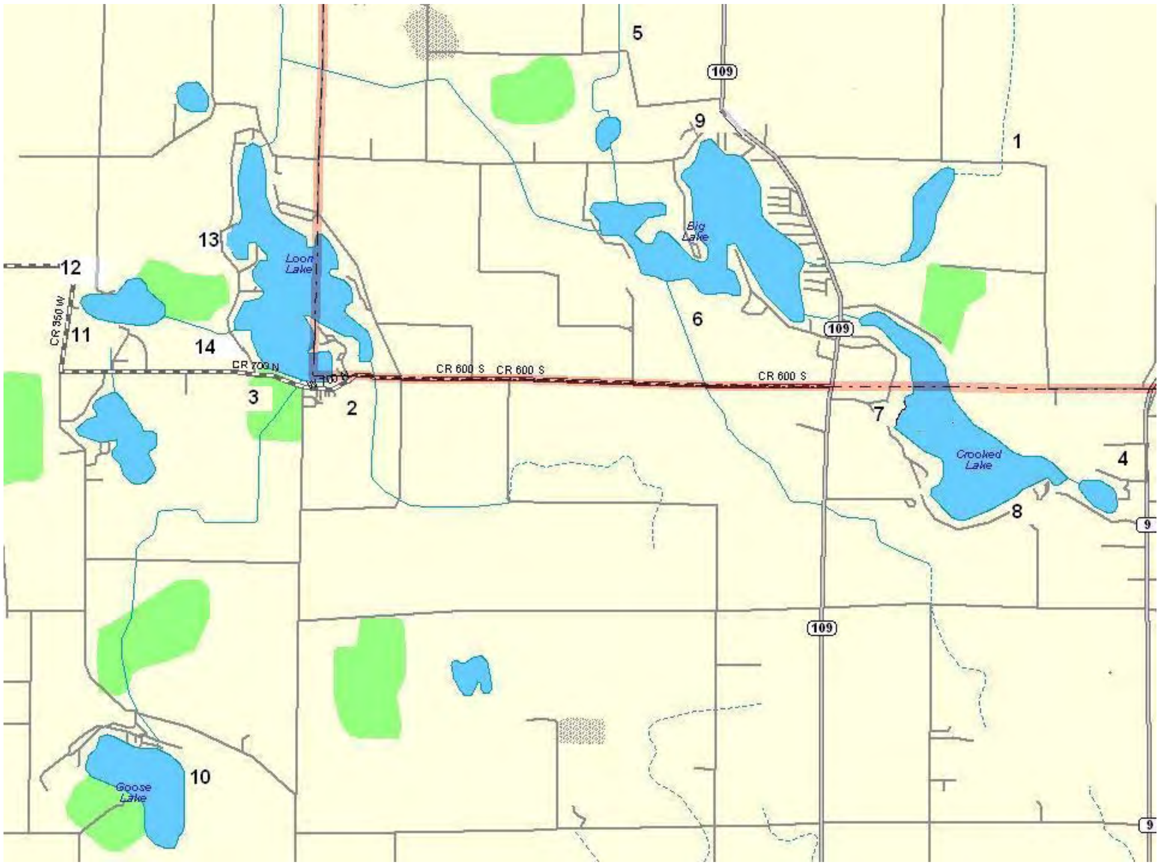
The Upper Tippecanoe River Lakes Association received a grant from the Indiana Department of Environmental Management's "Lake and River Enhancement" or LARE program to develop a watershed diagnostic plan. Part of the development of this plan includes water quality and biological monitoring to determine areas of the watershed that are ecologically damaged in some way. Monitoring was carried out during 2007. Chemical sampling included data from winter, a "base flow" sample (unless the stream was dry most of the year), and a "storm flow" sample. Biological sampling included benthic community analysis if the stream was not dry most of the year.

<u>Sample Sites</u>

			Latitude	Longitude
1	Crane Lake Inlet		41.16.46	85.28.45
2	Loon Lake Inlet 1	(Friskney Ditch)	41.15.28	85.31.47
3	Loon Lake Inlet 2	(Winters Ditch)	41.15.14	85.33.11
4	Little Crooked Lake Inlet		41.15.48	85.27.48
5	Green Lake Inlet		41.17.15	85.30.36
6	Big Lake South Inlet	(Sell Ditch)	41.16.12	85.30.16
7	Crooked Lake West Inlet		41.15.29	85.29.01
8	Crooked Lake South Inlet		41.15.22	85.28.24
9	Big Lake North Inlet		41.16.57	85.30.01
10	Goose Lake Inlet		41.14.07	85.32.32
11	Old Lake South Inlet		41.16.12	85.33.32
12	Old Lake North Inlet		41.16.19	85.33.31
13	Loon Lake West Inlet		41.16.42	85.32.40
14	Old Lake inlet to Loon Lake		41.16.35	85.32.40

Site 10 had flow only during storm events. Sites 13 and 14 were only sampled during storm flow.

Sampling Sites



Chemical Sampling

Water samples for laboratory analysis were collected in polyethylene plastic containers, preserved in the field where appropriate, and returned to the Commonwealth Biomonitoring laboratory for analysis.   Analysis of dissolved oxygen, pH, temperature, and conductivity were made on location using field instruments.

Macroinvertebrate Methods

Macroinvertebrate monitoring is a valuable tool to measure the ecological health of a stream. Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change, benthic (bottom-dwelling) organisms are considered to be the primary tool to document the biological condition of the streams. The numbers and kinds of animals present at a study site can be compared to an unimpacted reference site. The Little Wabash River at Broadway Street in Huntington was chosen as the reference in this study. It represents other nearby streams in this ecoregion and previous biological sampling by IDEM (unpublished AIMS data) showed that the biotic index value is among the highest in the immediate area. The bioassessment technique compares the community of the reference site with each study site. Higher biotic index values indicate more ecologically healthy streams.

Sample Collection (Macroinvertebrates)

Macroinvertebrate samples in this study were collected by dipnet in riffle areas where current speed approached 30 cm/sec. All samples were preserved in the field with 70% isopropanol. Samples were collected on May 8 and 10, 2007.

Laboratory Analysis (Macroinvertebrates)

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the animals collected in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species) using standard taxonomic references [4,5,6]. As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection. The list of animals found is listed by site number in the appendix.

Data Analysis (Macroinvertebrates)

Following identification of the animals in the sample, "metrics" were calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions. The macroinvertebrate data from this study were analyzed by four different sets of metrics. Data were analyzed with the mIBI protocol developed by the Indiana Department of Environmental Management [3], an adaptation of the Ohio EPA protocol [2], the original Lake and River Enhancement (LARE) program metrics recommended by EPA Bioassessment Protocol 3 [1], and a set of metrics developed later by the US EPA [7]. Each assessment protocol compares the aquatic community of study sites to a "reference" condition. A reference site is a stream of similar size in the same geographic area that is least impacted by human changes in the watershed. The reference stream in this study (the Little Wabash River near Huntington) had been identified previously as a nearby stream with high biotic integrity (IDEM, unpublished data from the AIMS database). To allow better comparisons between each scoring system, the scores reported below were all normalized to a percentage of the highest possible score.

The Qualitative Habitat Evaluation Index (QHEI) used by Ohio EPA [2] was used to determine available habitat for aquatic organisms. This index ranges from 0 (no habitat value) to 100 (highest possible habitat value).

Results

Chemistry

Results from individual sample sites are presented in the Appendix. A summary of individual parameters and their relationship to water quality is as follows:

Dissolved Oxygen: Within the Indiana water quality standards at most sites. Low D.O. at the Crooked Lakes inlets during the June "baseflow" sampling event was due to lack of flow in pooled areas rather than specific water pollution problems.

Nitrogen: All forms of nitrogen were low at all sites, except a high value [10 mg/l] at the Crane Lake inlet during January.

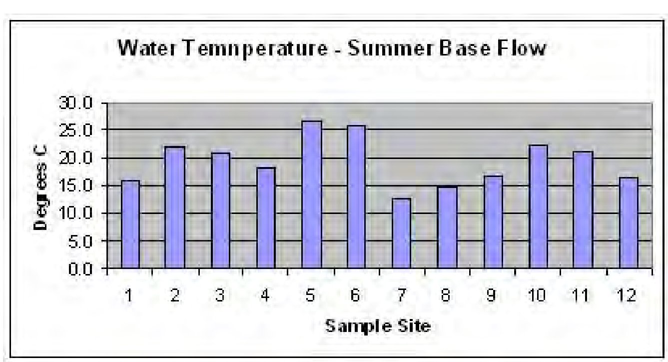
Turbidity: Total suspended solids values were low at all sites, even during the "stormflow" sampling.

Conductivity: Within normal values, indicating low dissolved solids at all sites.

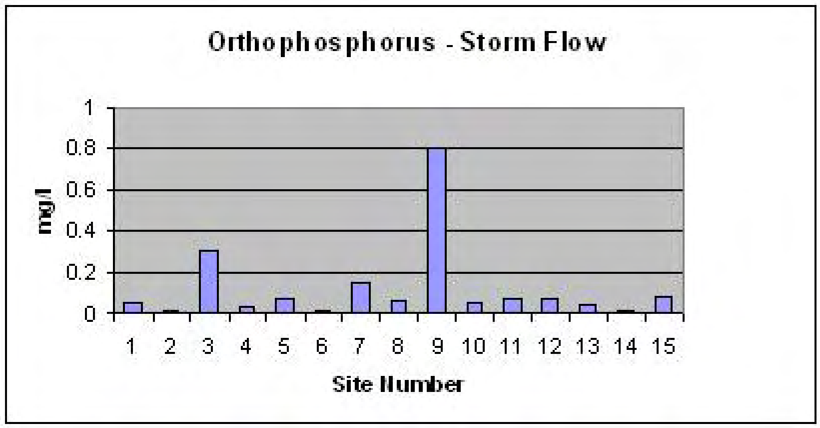
E. coli: Not all sites were monitored. However, values were near or below Indiana water quality standards for swimming at all sites except the inlet to Loon Lake on the northwestern side during storm flow.

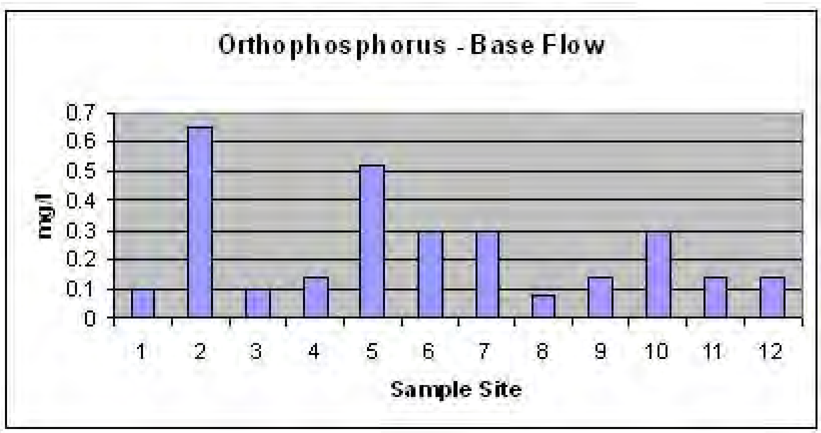
pH: Values greater than 8.3 often indicate high algal productivity associated with excessive nutrient inputs. High values occurred during base flow at Sell Ditch inflow to Big Lake and the Goose Lake inlet.

Temperature: Summer base flow samples had relatively low temperatures [less than 20 degrees C] at many sites. This usually indicates the strong influence of groundwater inputs. Groundwater inflow was especially noticeable at the Crane Lake inlet, the Crooked Lake west inlet, the Big Lake inlet, and the Old Lake north inlet.



Phosphorus: The most important form of phosphorus in determining the ecological health of a lake is “orthophosphorus” [the dissolved form most easily taken up by algae and other aquatic plants]. Results of storm flow and base flow sampling are shown below. Orthophosphorus was relatively low [less than 0.2 mg/l] at most lake inlet sites sampled. The sites with especially high phosphorus values that should be lowered to protect lake quality were the north inlet to Big Lake, the Friskney Ditch inlet to Loon Lake, and the inlet to Green Lake.



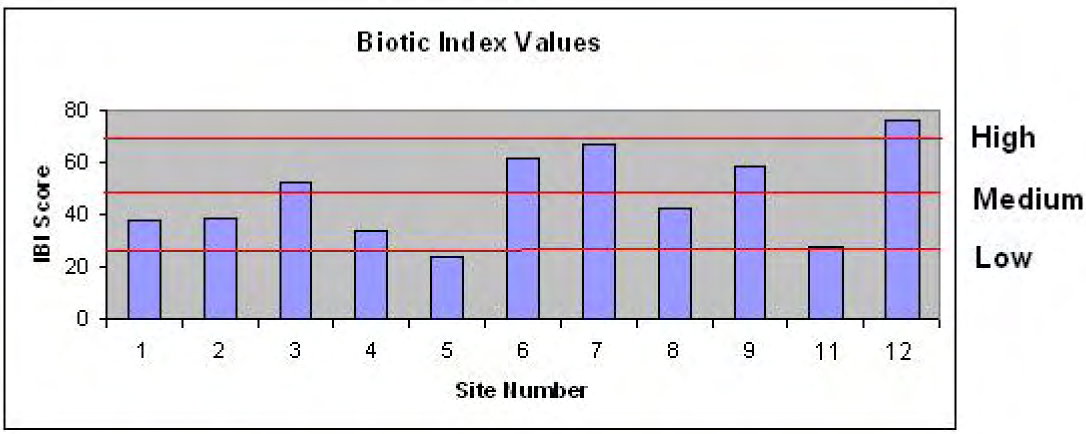


Macroinvertebrates

A total of 45 macroivertebrate genera were found during the study. Predominant forms included midge larvae (Chironomidae) and blackfly larvae (Simuliidae). Biotic scores by site number are presented in Table 1.

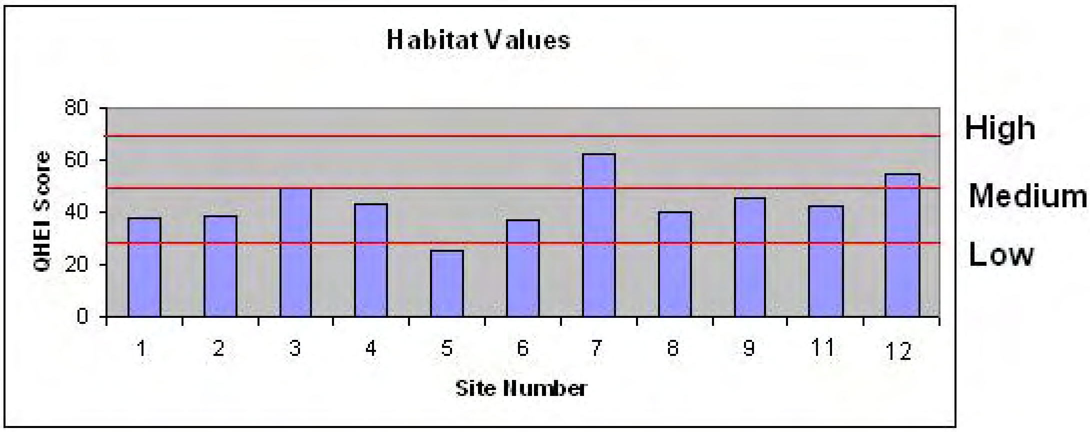
Table 1. Results of macroinvertebrate bioassessment by site number.

	Ref	1	2	3	4	5	6	7	8	9	11	12
mIBI	90	30	37	60	32	30	80	82	27	65	37	67
Ohio EPA	78	45	45	50	45	22	55	55	55	55	28	88
LARE	100	56	51	58	37	27	66	100	63	63	27	78
US EPA	100	20	24	40	24	16	44	32	24	48	20	72
Average	92	38	39	52	34	24	61	67	42	58	28	76



Habitat

QHEI values for most of the study sites examined were low. High quality biotic communities would not be expected in any of these streams. The individual scoring values and total values for each site are shown in the appendix.



Discussion

An examination of the macroinvertebrate bioassessment scores by the different protocols shows variation in ranking of sites from best to worse, but some patterns emerge. Green Lake inlet consistently scored poorly. This site had an unbalanced benthic community dominated by blackfly larvae. Old Lake South inlet also scored poorly, as its benthic community was dominated by a sediment-tolerant species of midge larvae (*Orthocladius obumbratus*).

Sites that had the highest biotic index scores, despite having less than desirable habitat scores, included Crooked Lake west inlet, Old Lake north inlet, and Sell Ditch draining into Big Lake from the south. These sites had more balanced benthic communities, including the intolerant groups of mayflies, stoneflies and caddisflies.

Recommendations

Emphasize best management practices for water quality improvement in the subwatersheds upstream from sites 5, 9 and 11. Find and eliminate sources of E.coli loading in the small drainage area feeding Loon Lake on the northwest side [upstream from site 13].

References

1. Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. US Environmental Protection Agency, Office of Water, Washington, D.C. EPA/444/4-89-001.

2. Ohio EPA. 1987. Biological criteria for the protection of aquatic life: Vol. II. Users manual for biological field assessment of Ohio surface waters. Div. of Water Quality Monitoring and Assessment, Columbus, OH.

3. Indiana Department of Environmental Management, 1999. Metrics for analysis of benthic macroinvertebrate samples collected from artificial substrates. PowerPoint Presentation to the Ohio Valley Chapter of SETAC. Office of Water Management, Biological Studies Section, Indianapolis, IN.

4. Simpson, K.W. and R.W. Bode. 1980. Common Larvae of Chironomidae (Diptera) from New York State Streams and Rivers. Bull. No. 439. NY State Museum, Albany, NY. 105 pp.

5. Schuster, G.A. and D.A. Etnier. 1978. A manual for the identification of the larvae of the caddisfly genera Hydropsyche and Symphitopsyche in Eastern and Central North America. U.S. EPA Environmental Support Laboratory, Cincinnati, OH (EPA-600/4-78-060.

6. Merritt, R.W. and K.W. Cummins. 1996. An Introduction to the Aquatic Insects of North America, Third Edition. Kendall/Hunt Publishing Co., Dubuque, Iowa. 862 pp.

7. U.S. EPA, 1999. Rapid bioassessment protocols for use in wadeable streams and rivers. Office of Water, Washington, D.C. (EPA 841-B-99-002).

APPENDIX

QHEI Data

	Substrate	Cover	Channel	Riparian	Pool	Riffle	Gradient	TOTAL
Site 1	9	5	7	4	4	3	6	38
Site 2	8	3	7	5	7	3	6	39
Site 3	13	5	10	7	5	3	6	49
Site 4	9	6	8	5	5	2	8	43
Site 5	4	2	6	3	5	2	4	26
Site 6	9	3	7	4	7	3	4	37
Site 7	15	10	13	8	5	3	8	62
Site 8	9	6	8	5	4	2	6	40
Site 9	14	6	7	4	5	3	6	45
Site 11	12	6	8	4	5	1	6	42
Site 12	17	6	9	4	5	6	8	55
Ref..	17	13	14	9	10	7	6	76

Site Number		Ref.	1	2	3	4	5
Ephemeroptera (Mayflies)	Stenacron interpunctatum	5					
	Stenonema terminatum	2					
	Baetis hageni						
	B. flavistriga						
	Caenis spp.	1		4			
Trichoptera (Caddisflies)	Limnephilidae						
	Hydropsyche betteni						
	Cheumatopsyche spp.	37			3	1	
	Ceratopsyche bifida	3					
	Chimarra obscura	1					
Plecoptera (Stoneflies)	Perlidae				2		
	Amphinemura spp.						
	Capnidae				3		
Coleoptera (Beetles)	Stenelmis spp.	17					
	Optioservius fastiditus	3					
	Dubiraphia spp.				1		
	Dytiscidae		4		3		1
Odonata (Damsel & Dragonflies)	Argia spp.			1	3		
	Boyeria spp.		1				
Diptera (Flies)	Simulidae					79	81
	Ephydridae				1		
	Ceratopoginae			1			
	unknown dipteran pupa			4			
	Tipula spp.						
	Pseudolimnophila spp.						
Chironomidae (midges)	Thienemannimyia spp.	3		5	10		
	Procladius spp.			3			
	Cricotopus bicinctus	2	12	13		2	
	C. sylvestris	4	3				
	Orthocladius obumbratus	10	27	27		12	13
	Cardiocladius spp.						
	Nanocladius spp.			3		2	
	Eukiefferiella pseudomontana		4				
	Thienemanniella xena						
	Glyptotendipes lobiferus			3			
	Polypedilum convicturm	11	4		6		
	Dicrotendipes spp.		3				
	Paratendipes albimanus		8				
	Endochironomus nigricans						
	Microspectra polita			5	10		
	Tanytarsus guerlus		8	5		1	5
Crustacea	Isopoda		8		1		
	Amphipoda		17	2	3		
Annelida	Hirudinea			12			
	Oligochaetes	1	1	12	1	3	
Mollusca	Sphaeridae				53		
TOTAL		100	100	100	100	100	100

Site Number		6	7	8	9	11	12
Ephemeroptera (Mayflies)	Stenacron interpunctatum						
	Stenonema terminatum						
	Baetis hageni						11
	B. flavistriga						2
	Caenis spp.	39			4		
Trichoptera (Caddisflies)	Limnephilidae		3				
	Hydropsyche betteni						8
	Cheumatopsyche spp.	3			7		25
	Ceratopsyche bifida						
	Chimarra obscura						
Plecoptera (Stoneflies)	Perlidae	1					
	Amphinemura spp.		58				
	Capnidae						
Coleoptera (Beetles)	Stenelmis spp.	1			15		
	Optioservius fastiditus						
	Dubiraphia spp.						
	Dytiscidae	2	6	8		1	1
Odonata (Damsel &	Argia spp.			1	1		
Dragonflies)	Boyeria spp.						
Diptera (Flies)	Simulidae		2	2	1		21
	Ephydridae		3				
	Ceratopoginae						
	unknown dipteran pupa						
	Tipula spp.						2
	Pseudolimnophila spp.				1		
Chironomidae (midges)	Thienemannimyia spp.	2					2
	Procladius spp.						
	Cricotopus bicinctus	16	2		9		2
	C. sylvestris						
	Orthocladius obumbratus	18	6		10	79	4
	Cardiocladius spp.		2				
	Nanocladius spp.	2					
	Eukiefferiella pseudomontana						
	Thienemanniella xena		3				
	Glyptotendipes lobiferus						
	Polypedilum convicturm			31			14
	Dicrotendipes spp.			3			
	Paratendipes albimanus	4					
	Endochironomus nigricans			4			
	Microspectra polita		8	31		7	
	Tanytarsus guerlus				1		6
Crustacea	Isopoda				2	10	2
	Amphipoda	4	6	17	47	1	
Annelida	Hirudinea	1		3	2	1	
	Oligochaetes	3	1			1	
Mollusca	Sphaeridae	4					
TOTAL		100	100	100	100	100	100

UTRLA Water Chemistry
January 2007 Samples

Site			TP	Ortho-P	NO3	NH3	Total N	TSS
	1 Jan. 2007		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1		Crane Lake Inlet	0.04	0.02	14	0.5	17	1
2		Loon Lake Inlet 1 (Friskney)	0.04	0.02	5.8	0.4	6	8
3		Loon Lake Inlet 2 (Winters)	0.16	0.05	3.2	0.4	22	5
4		Little Crooked Lake Inlet	0.02	0.02	0.6	0.8	2	11
5		Green Lake Inlet	0.75	0.07	7.5	0.5	13	4
6		Big Lake South Inlet (Sell Ditch)	0.1	0.05	4.8	0.4	12	12
7		Crooked Lake West Inlet	0.05	0.02	0.4	0.4	10	7
8		Crooked Lake South Inlet	0.05	0.03	0.2	0.4	1	4
	24 Jan. 2007							
9		Big Lake North Inlet	0.56	0.42	4.8	1.4	6	7
11		Old Lake South Inlet	1.6	0.4	2	1.2	4	4
12		Old Lake North Inlet	0.14	0.12	1	0.7	2	5

UTRLA Water Chemistry
August 7, 2007 Samples

Storm Flow Conditions 27 cfs flow at North Webster gauging station

Flow cfs		TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C
0.59	Crane Lake Inlet	0.1	0.05	1.8	0.7	0.7	25.5	5.0	6.9	590	20.0
2.70	Loon Lake Inlet 1 (Friskney)	0.02	0.01	0.6	0.9	1.3	12.5	10.5	7.6	580	28.5
5.40	Loon Lake Inlet 2 (Winters)	0.4	0.3	1.3	0.9	0.9	6.5	8.4	7.2	570	27.9
0.27	Little Crooked Lake Inlet	0.04	0.03	0.3	0.6	0.8	11.5	6.2	7.4	930	23.2
0.54	Green Lake Inlet	0.12	0.07	0.9	0.9	0.9	6	3.4	7.0	640	25.8
4.59	Sell Ditch	0.06	0.01	0.3	0.7	0.7	6.5	18.7	8.0	680	28.0
0.14	Crooked Lake West Inlet	0.3	0.15	1.2	0.7	0.7	13	5.4	7.0	340	22.6
0.19	Crooked Lake South Inlet	0.08	0.06	0.6	0.9	0.9	4.5	5.0	6.9	630	25.9
1.62	Big Lake North Inlet	1.1	0.8	1.1	1.1	1.7	28	4.4	6.9	1000	21.4
0.27	Goose Lake Inlet	0.1	0.05	0.3	0.8	0.8	10	6.0	7.2	620	29.0
0.59	Old Lake South Inlet	0.1	0.07	0.3	0.7	0.7	2.5	4.7	7.0	580	26.8
0.32	Old Lake North Inlet	0.08	0.07	0.3	1.3	1.5	4	5.3	7.2	630	21.5
0.1	Loon Lake West Inlet	0.05	0.04	1.2	1.3		5.5				
1	Old Lake inlet to Loon Lake	0.02	0.01	0.3	0.9		3.5				
	Green Lake Inlet duplicate	0.13	0.08	0.8	0.9		6				

Storm Flow Conditions - October 18, 2007

Flow cfs		E.coli
0.5	Old Lake South Inlet	151
0.5	Old Lake North Inlet	185
0.4	Loon Lake West Inlet	508

UTRLA Water Chemistry
June 6, 2007 Samples

Base Flow Conditions 8 cfs flow at North Webster gauging station

Flow cfs		TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C	E.coli /100 ml
0.18	Crane Lake Inlet	0.5	0.1	3.5	0.32	0.8	7	11.0	7.9	680	15.8	240
0.80	Loon Lake Inlet 1 (Friskney)	2.7	0.65	1	0.55	1.2	17.5	11.2	8.0	580	22.0	4
1.60	Loon Lake Inlet 2 (Friskney)	0.46	0.1	1.6	0.32	0.6	5	12.0	8.2	560	21.0	186
0.08	Little Crooked Lake Inlet	1.4	0.14	1	0.4	0.5	8	5.6	7.5	1080	18.2	
0.16	Green Lake Inlet	2.2	0.52	5	0.85	0.9	8	11.2	8.2	660	26.5	
1.36	Sell Ditch	0.35	0.3	2.1	0.35	0.4	14.5	18.7	8.5	810	25.9	59
0.04	Crooked Lake West Inlet	0.46	0.3	0.8	0.2	0.4	5	3.7	7.3	1070	12.5	
0.06	Crooked Lake South Inlet	0.28	0.08	0.6	0.19	0.8	22	1.5	7.2	560	14.8	
0.48	Big Lake North Inlet	1.4	0.14	2.8	0.75	0.8	15	6.9	7.5	710	16.8	
0.08	Goose Lake Inlet	0.35	0.3	0.5	0.48	0.5	6.5	11.9	8.6	350	22.3	14
0.18	Old Lake South Inlet	0.4	0.14	0.9	0.4	0.6	2.5	13.0	8.0	640	21.2	38
0.10	Old Lake North Inlet	0.5	0.14	1.3	0.6	0.6	7.5	7.2	7.7	780	16.5	

Upper Tippecanoe River Lakes Association
Trophic Status Data - Most Recent Data

Lake	NH3-N mg/l	NO3-N mg/l	Org-N mg/l	TN mg/l	SRP mg/l	chl-a	BG Dom.	TSI-2000
Big Lake	0.7	0.01	1.9	2.6	0.13	17	64	40
Crooked Lake	0.4	0.05	0.7	1.2	0.07	2	62	23
Crane Lake	0.7	0.9	1.8	3.4	0.19	25	88	51
Goose Lake	1.1	0.3	2.6	4	0.21	45	98	60
Green Lake	0.5	0.7	2.2	3.4	0.16	30	3	51
Little Crooked Lake	3.1	0.01	5.3	8.4	0.5	22	27	39
Loon Lake	0.8	0.6	1.9	3.3	0.19	58	53	48
New Lake	0.6	0.02	1.2	1.8	0.15	2	83	25
Old Lake	0.9	0.8	2	3.7	0.35	8	94	67
Average	1.0	0.4	2.2	3.5	0.2			45

Lake	NH3-N mg/l	NO3-N mg/l	Org-N mg/l	TN mg/l	SRP mg/l	chl-a	BG Dom.	TSI-1970	Change
Big Lake	0.2	0.6	0.1	0.83	0.17		yes	38	2
Crooked Lake	0.1	0.2	0.4	0.7	0.03		no	3	20
Crane Lake	0.3	3	1.3	4.6	0.03		yes	45	-6
Goose Lake	0.1	0.4	0.7	1.2	0.03		yes	61	-1
Green Lake									
Little Crooked Lake	0.4	0.5	0.5	1.4	0.03		yes	32	7
Loon Lake	0.2	0.6	0.9	1.7	0.04		yes	46	2
New Lake	0.1	0.1	0.3	0.5	0.03		no	7	18
Old Lake	0.5	0.1	0.5	1.1	0.1		yes	48	19
Average	0.2	0.7	0.6	1.5	0.1			35	

Nutrient concentrations in the watershed have doubled
Crooked Lake, Old Lake, and New Lake have the greatest water quality declines
New Lake and Crooked Lake are now dominated by bluegreen algae but formerly were not

	Ref.s	Crane	Loon1	Loon2	L.Crook	Green	Big S	CrookW	CrookS	Big N	Old S	Old N
Stenacron	5											
Stenonema terminatum	2											
Baetis hageni												11
B. flavistriga												2
Caenis	1		4				39			4		
Limnephilidae								3				
Hydropsyche betteni												8
Cheumatopsyche	37			3	1		3			7		25
Certopsyche bifida	3											
Chimarra obscura	1											
Perlidae				2			1					
Amphinemura								58				
Capnidae				3								
Stenelmis	17						1			15		
Optioservius	3											
Dubiraphia				1								
Dytiscidae		4		3		1	2	6	8		1	1
Argia			1	3					1	1		
Boyeria		1										
Simulidae					79	81		2	2	1		21
Ephydridae				1				3				
Ceratopoginae			1									
unknown diptera pupa			4									
Tipula												2
Pseudolimnophila										1		
Chironomidae												
Thienemannimyia	3		5	10			2					2
Procladius			3									
Cricotopus bicinctus	2	12	13		2		16	2		9		2
C. sylvestris	4	3										
Orthocladius obumbratus	10	27	27		12	13	18	6		10	79	4
Cardiocladius								2				
Nanocladius spp.			3		2		2					
Eukiefferiella pseudomontana		4										
Thienemanniella xena								3				
Glyptotendipes			3									
Polypedilum convicturm	11	4		6					31			14
Dicrotendipes		3							3			
Paratendipes		8					4					
Endochironomus nigricans									4			
Microspectra			5	10				8	31		7	
Tanytarsus		8	5		1	5				1		6
Isopoda		8		1						2	10	2
Amphipoda		17	2	3			4	6	17	47	1	
Hirudinea			12				1		3	2	1	
Oligochaetes	1	1	12	1	3		3	1			1	
Sphaeridae				53			4					
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

ept		49	0	4	8	1	0	43	61	0	11	0	46
chironomids		30	69	64	26	17	18	42	21	69	20	86	28
ratio		1.63	0	0.06	0.31	0.0588	0	1.02	2.90476	0	0.55	0	1.64

	1	2	3	4	5	6	7	8	9	10	11	12
Stenacron			5									
Stenonema terminatum			2									
Baetis hageni								11				
B. flavistriga								2				
Caenis		4	1								39	4
Limnephilidae	3											
Hydropsyche betteni								8				
Cheumatopsyche			37	3		1		25			3	7
Certopsyche bifida			3									
Chimarra obscura			1									
Perlidae				2							1	
Amphinemura	58											
Capnidae				3								
Stenelmis			17								1	15
Optioservius			3									
Dubiraphia				1								
Dytiscidae	6			3	8		1	1	1	4	2	
Argia		1		3	1							1
Boyeria										1		
Simulidae	2				2	79	81	21				1
Ephydridae	3			1								
Ceratopoginae		1										
unknown diptera pupa		4										
Tipula								2				
Pseudolimnophila												1
Chironomidae												
Thienemannimyia		5	3	10				2			2	
Procladius		3										
Cricotopus bicinctus	2	13	2			2		2		12	16	9
C. sylvestris			4							3		
Orthocladius obumbratus	6	27	10			12	13	4	79	27	18	10
Cardiocladius	2											
Nanocladius spp.		3				2					2	
Eukiefferiella pseudomontana										4		
Thienemanniella xena	3											
Glyptotendipes		3										
Polypedilum convicturm			11	6	31			14		4		
Dicrotendipes					3					3		
Paratendipes										8	4	
Endochironomus nigricans					4							
Microspectra	8	5		10	31				7			
Tanytarsus		5				1	5	6		8		1
Isopoda				1				2	10	8		2
Amphipoda	6	2		3	17				1	17	4	47
Hirudinea		12			3				1		1	2
Oligochaetes	1	12	1	1		3			1	1	3	
Sphaeridae				53							4	
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100

1 Crooked Lake West Inlet
2. Loon Lake Boat Ramp Inlet
3 Little Wabash Huntington (ref site)
4. Loon Lake South Inlet
5. Crooked Lake South Inlet
6. Little Crooked Lake inlet Hwy 9
7. Green Lake inlet
8. Old Lake North Inlet
9. Old Lake South Inlet
10. Crane Lake inlet
11. Big Lake South Inlet
12 Big Lake north inlet

Sample dates May 8 and 10, 2007

	site	1	2	3	4	5	6	7	8	9	10	11	12
% mayfly		0	4	8	0	0	0	0	13	0	0	39	4
% caddisfly		3	0	41	3	0	1	0	33	0	0	3	7
nontanytarsod		25	85	31	75	60	98	94	47	92	87	54	72
% tanytarsids		8	10	0	10	31	1	5	6	7	8	0	1
%tolerant		3	37	3	1	6	5	0	2	2	16	20	11

	1	2	3	4	5	6	7	8	9	10	11	12
# genera												
# mayfly taxa												
# caddisfly taxa												
# dipteran taxa												
% tanytarsids												
%mayfly												
% caddisfly												
% tolerant												
% non tanytarsid/non insects												
% dominant												
# genera												
# mayfly taxa												
# caddisfly taxa												
# dipteran taxa												
% tanytarsids												
%mayfly												
% caddisfly												
% tolerant												
% non tanytarsid/non insects												
% dominant												
score	20	16	28	18	20	16	8	32	10	16	20	16
normalized score	33	27	47	30	33	27	13	53	17	27	33	27
	Ref.site	Crane	Loon1	Loon2	L.Cro	Gree	Big S	Crook	Crook	Big N	Old S	Old N
# genera	13	12	15	14	7	4	10	12	9	12	7	12
# mayfly taxa	3	0	1	0	0	0	1	0	0	1	0	2
# caddisfly taxa	3	0	0	1	1	0	2	1	0	1	0	2
# dipteran taxa	5	8	10	4	5	3	5	7	5	5	2	7
% tanytarsids	0	8	10	10	1	5	0	8	31	1	7	6
%mayfly	8	0	4	0	0	0	39	0	0	4	0	13
% caddisfly	41	0	0	3	1	0	3	3	0	7	0	33
% tolerant	3	16	37	1	5	0	20	3	6	11	2	2

% non tanytarsid	31	87	85	75	98	94	54	25	60	72	92	47
% dominant	37	27	27	53	79	81	42	58	31	47	79	25
	Ref.site	Crane	Loon1	Loon2	L.Cro	Gree	Big S	Crook	Crook	Big N	Old S	Old N
# genera	2	2	4	4	2	0	2	2	2	2	2	2
# mayfly taxa	2	0	0	0	0	0	0	0	0	0	0	2
# caddisfly taxa	2	0	0	2	2	0	2	2	0	2	0	2
# dipteran taxa	2	4	4	2	2	0	2	2	2	2	0	2
% tanytarsids	0	2	2	2	2	2	0	2	6	2	2	2
%mayfly	2	0	2	0	0	0	6	0	0	2	0	4
% caddisfly	6	0	0	2	2	0	2	2	0	2	0	6
% tolerant	6	4	0	6	6	6	4	6	6	4	6	6
% non tanytarsid	4	0	0	0	0	0	2	4	2	0	0	2
% dominant	2	4	4	0	0	0	0	0	2	0	0	4
score	28	16	16	18	16	8	20	20	20	20	10	32
normalized score	47	27	27	30	27	13	33	33	33	33	17	53

	1 (rRefe	2	3	4	5	6	7	8	9	10	11	12
HBI												
taxa rich												
# ind												
% dom												
EPT index												
EPT count												
% EPT												
EPT/Chir												
# chironomids												
ind/sqaures												
	1 (rRefe	2	3	4	5	6	7	8	9	10	11	12
HBI												
taxa rich												
# ind												
% dom												
EPT index												
EPT count												
% EPT												
EPT/Chir												
# chironomids												
ind/sqaures												

UTRLA Water Chemistry
June 6, 2007 Samples
Base Flow Conditions 8 cfs flow at North Webster guaging station

Sampling Site	Subwatershed		Flow cfs	TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C	E.coli /100 ml
1	L	Crane Lake Inlet	0.18	0.5	0.1	3.5	0.32	0.8	7	11.0	7.9	680	15.8	240
2	F	Loon Lake Inlet 1 (Friskney)	0.80	2.7	0.65	1	0.55	1.2	17.5	11.2	8.0	580	22.0	4
3	E	Loon Lake Inlet 2 (Friskney)	1.60	0.46	0.1	1.6	0.32	0.6	5	12.0	8.2	560	21.0	186
4	K	Little Crooked Lake Inlet	0.08	1.4	0.14	1	0.4	0.5	8	5.6	7.5	1080	18.2	
5	H	Green Lake Inlet	0.16	2.2	0.52	5	0.85	0.9	8	11.2	8.2	660	26.5	
6	I	Sell Ditch	1.36	0.35	0.3	2.1	0.35	0.4	14.5	18.7	8.5	810	25.9	59
7	J	Crooked Lake West Inlet	0.04	0.46	0.3	0.8	0.2	0.4	5	3.7	7.3	1070	12.5	
8	J	Crooked Lake South Inlet	0.06	0.28	0.08	0.6	0.19	0.8	22	1.5	7.2	560	14.8	
9	H	Big Lake North Inlet	0.48	1.4	0.14	2.8	0.75	0.8	15	6.9	7.5	710	16.8	
10	E	Goose Lake Inlet	0.08	0.35	0.3	0.5	0.48	0.5	6.5	11.9	8.6	350	22.3	14
11	A	Old Lake South Inlet	0.18	0.4	0.14	0.9	0.4	0.6	2.5	13.0	8.0	640	21.2	38
12	B	Old Lake North Inlet	0.10	0.5	0.14	1.3	0.6	0.6	7.5	7.2	7.7	780	16.5	

UTRLA Water Chemistry
January 2007 Samples

Site			TP	Ortho-P	NO3	NH3	Total N	TSS
	1 Jan. 2007		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1		Crane Lake Inlet	0.04	0.02	14	0.5	17	1
2		Loon Lake Inlet 1 (Friskney)	0.04	0.02	5.8	0.4	6	8
3		Loon Lake Inlet 2 (Winters)	0.16	0.05	3.2	0.4	22	5
4		Little Crooked Lake Inlet	0.02	0.02	0.6	0.8	2	11
5		Green Lake Inlet	0.75	0.07	7.5	0.5	13	4
6		Big Lake South Inlet (Sell Ditch)	0.1	0.05	4.8	0.4	12	12
7		Crooked Lake West Inlet	0.05	0.02	0.4	0.4	10	7
8		Crooked Lake South Inlet	0.05	0.03	0.2	0.4	1	4
	24 Jan. 2007							
9		Big Lake North Inlet	0.56	0.42	4.8	1.4	6	7
11		Old Lake South Inlet	1.6	0.4	2	1.2	4	4
12		Old Lake North Inlet	0.14	0.12	1	0.7	2	5

UTRLA Water Chemistry
August 7, 2007 Samples
Storm Flow Conditions

27 cfs flow at North Webster guaging station

Sampling Site	Subwatershed	Waterway	Flow cfs	TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C
1	L	Crane Lake Inlet	0.59	0.1	0.05	1.8	0.7	0.7	25.5	5.0	6.9	590	20.0
2	F	Loon Lake Inlet 1 (Friskney)	2.70	0.02	0.01	0.6	0.9	1.3	12.5	10.5	7.6	580	28.5
3	E	Loon Lake Inlet 2 (Winters)	5.40	0.4	0.3	1.3	0.9	0.9	6.5	8.4	7.2	570	27.9
4	K	Little Crooked Lake Inlet	0.27	0.04	0.03	0.3	0.6	0.8	11.5	6.2	7.4	930	23.2
5	H	Green Lake Inlet	0.54	0.12	0.07	0.9	0.9	0.9	6	3.4	7.0	640	25.8
6	I	Sell Ditch	4.59	0.06	0.01	0.3	0.7	0.7	6.5	18.7	8.0	680	28.0
7	J	Crooked Lake West Inlet	0.14	0.3	0.15	1.2	0.7	0.7	13	5.4	7.0	340	22.6
8	J	Crooked Lake South Inlet	0.19	0.08	0.06	0.6	0.9	0.9	4.5	5.0	6.9	630	25.9
9	H	Big Lake North Inlet	1.62	1.1	0.8	1.1	1.1	1.7	28	4.4	6.9	1000	21.4
10	E	Goose Lake Inlet	0.27	0.1	0.05	0.3	0.8	0.8	10	6.0	7.2	620	29.0
11	A	Old Lake South Inlet	0.59	0.1	0.07	0.3	0.7	0.7	2.5	4.7	7.0	580	26.8
12	B	Old Lake North Inlet	0.32	0.08	0.07	0.3	1.3	1.5	4	5.3	7.2	630	21.5
13	C	Loon Lake West Inlet	0.1	0.05	0.04	1.2	1.3		5.5				
14	C	Old Lake inlet to Loon Lake	1	0.02	0.01	0.3	0.9		3.5				
	H	Green Lake Inlet duplicate		0.13	0.08	0.8	0.9		6				

Storm Flow Conditions - October 18, 2007

Flow cfs		E.coli
0.5	Old Lake South Inlet	151
0.5	Old Lake North Inlet	185
0.4	Loon Lake West Inlet	508

UTRLA Water Chemistry
June 6, 2007 Samples
Base Flow Conditions 8 cfs flow at North Webster guaging station

Sampling Site	Subwatershed		Flow cfs	TP mg/l	Ortho-P mg/l	NO3 mg/l	NH3 mg/l	TKN mg/l	TSS mg/l	D.O. mg/l	pH SU	Cond. uS	Temp. C	E.coli /100 ml
1	L	Crane Lake Inlet	0.18	0.5	0.1	3.5	0.32	0.8	7	11.0	7.9	680	15.8	240
2	F	Loon Lake Inlet 1 (Friskney)	0.80	2.7	0.65	1	0.55	1.2	17.5	11.2	8.0	580	22.0	4
3	E	Loon Lake Inlet 2 (Friskney)	1.60	0.46	0.1	1.6	0.32	0.6	5	12.0	8.2	560	21.0	186
4	K	Little Crooked Lake Inlet	0.08	1.4	0.14	1	0.4	0.5	8	5.6	7.5	1080	18.2	
5	H	Green Lake Inlet	0.16	2.2	0.52	5	0.85	0.9	8	11.2	8.2	660	26.5	
6	I	Sell Ditch	1.36	0.35	0.3	2.1	0.35	0.4	14.5	18.7	8.5	810	25.9	59
7	J	Crooked Lake West Inlet	0.04	0.46	0.3	0.8	0.2	0.4	5	3.7	7.3	1070	12.5	
8	J	Crooked Lake South Inlet	0.06	0.28	0.08	0.6	0.19	0.8	22	1.5	7.2	560	14.8	
9	H	Big Lake North Inlet	0.48	1.4	0.14	2.8	0.75	0.8	15	6.9	7.5	710	16.8	
10	E	Goose Lake Inlet	0.08	0.35	0.3	0.5	0.48	0.5	6.5	11.9	8.6	350	22.3	14
11	A	Old Lake South Inlet	0.18	0.4	0.14	0.9	0.4	0.6	2.5	13.0	8.0	640	21.2	38
12	B	Old Lake North Inlet	0.10	0.5	0.14	1.3	0.6	0.6	7.5	7.2	7.7	780	16.5	

	Sampling Sites										
	1	2	3	4	5	6	7	8	9	11	12
Substrate	9	8	13	9	4	9	15	9	14	12	17
Cover	5	3	5	6	2	3	10	6	6	6	6
Channel	7	7	10	8	6	7	13	8	7	8	9
Riparian	4	5	7	5	3	4	8	5	4	4	4
Pool	4	7	5	5	5	7	5	4	5	5	5
Riffle	3	3	3	2	2	3	3	2	3	1	6
Gradient	6	6	6	8	4	4	8	6	6	6	8
TOTAL	38	39	49	43	26	37	62	40	45	42	55

Appendix D

UTRLA Seven Lakes Photos of Water Quality Sampling Sites


Sampling Site 1 – Crane Lake Inlet


Sampling Site 2 – Friskney Ditch

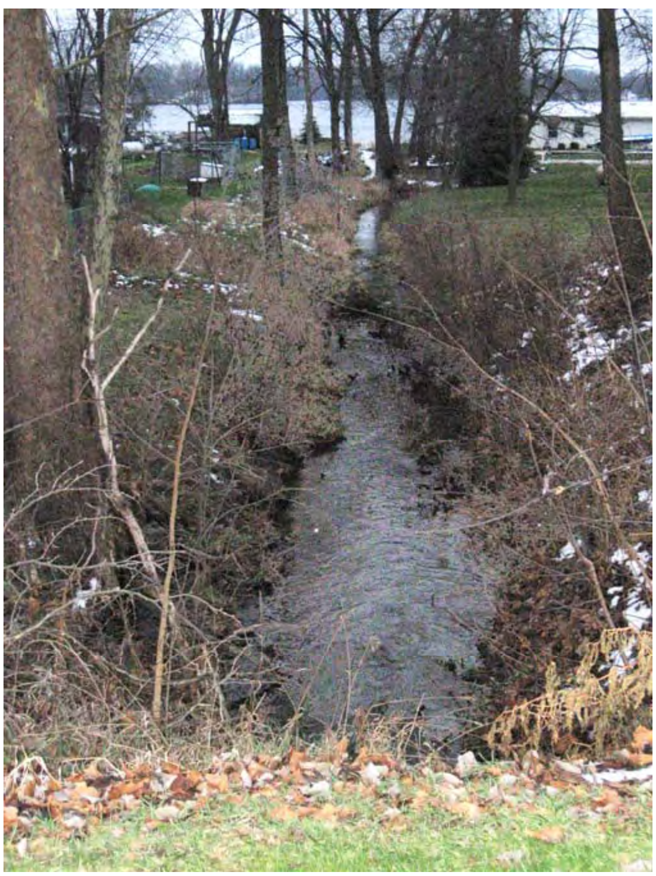

Sampling Site 3 – Winters Ditch


Sampling Site 4 – Little Crooked Lake Inlet

Sampling Site 5 – Haroff Branch

Sampling Site 6 – Sell Ditch

Sampling Site 8 – Crooked Lake south inlet



Sampling Site 9 – Stuckman Ditch

Sampling Site 10 – Goose Lake Inlet

Sampling Site 11 – Old Lake South Inlet


Sampling Site 12 – Old Lake North Inlet


Sampling Site 13 – Loon Lake West Inlet 1

Sampling Site 14 – Loon Lake West Inlet 2

Appendix E

UTRLA Seven Lakes
Tier I
Aquatic Vegetation
Reconnaissance Survey
Protocol
and
Field Data Sheets

SPECIES CODES

Species Code	Scientific Name	Common Name	Vegetation Type
ALGA	Any species of filamentous alga (incl. Spyrogyra, Cladophora, Hydrodictyon)	algae	NV
AZ?OL	Azollasp.	a mosquito fern sp.	NV
AZCA	Azolla caroliana	Carolina mosquito fern	NV
AZME	Azolla mexicana	Mexican mosquito fern	NV
CACA	Cabomba caroliniana	fanwort	
CEDE4	Ceratophyllum demersum	coontail	SB
CEPOCC	Cephalanthus occidentalis	buttonbush	EM
CH?AR	Charasp.	a chara sp.	SB
CHAS	Chara aspera	SB	
CHBR	Chara braunii	SB	
CHBR2	Chara brittonii	SB	
CHCO	Chara contraria	SB	
DECVER	Decodon verticillatus	swamp loosestrife	EM
ELCA7	Elodea canadensis	Canadian waterweed	SB
ELNU2	Elodea nuttalli	western waterweed	SB
HIBMOS	Hibiscus moscheutos L	crimsoneyed rosemallow	EM
LEMN	Species within the Lemnaceae	duckweeds	NV
LEMI3	Lemna minor	small or common duckweed	NV
LETR	Lemna trisulca	star duckweed	NV
LUDE4	Ludwigia decurrens	primrose-willow	FL
LVWORT	Ricciasp., Ricciocarpussp.	a liverwort species	NV
LYTSAL	Lythrum salicaria	purple loosestrife	EM
MYSI	Myriophyllum sibiricum	northern watermilfoil	SB
MYSP2	Myriophyllum spicatum	Eurasian watermilfoil	SB
MY?RI	Myriophyllum, unidentified species	a watermilfoil sp.	SB
NAFL	Najas flexilis	slender naiad	SB
NAGR	Najas gracillima	slender waternymph	SB
NAGU	Najas guadalupensis	southern waternymph	SB
NAMI	Najas minor	brittle waternymph	SB
NLPW	Potamogeton foliosus, P. pusillus,or other unidentified narrow-leaved pondweeds	narrow-leaved pondweeds	SB
NELU	Nelumbo lutea	American lotus	FL
NI?TE	Nitellasp.	a nitella sp.	SB
NOAQVG		no aquatic vegetation in site	NV
NULU	Nuphar variegetum(formerly N. luteum)	yellow pond lily (spatterdock)	FL
NYTU	Nymphaea tuberosa	white water lily	FL
PHAARU	Phalaris arundinaca	reed canary grass	EM
POLHYD	Polygonum hydropiperoides	smartweed	EM
POAL8	Potamogeton alpinus	red or alpine pondweed	SB
POTAMP	Potamogeton amplifolius	largeleaf pondweed	SB
POCR3	Potamogeton crispus	curly-leaf pondweed	SB
POEP2	Potamogeton epihydrus	ribbon-leaf pondweed	SB
POFO3	Potamogeton foliosus	leafy pondweed	SB
POGR8	Potamogeton gramineus	variable pondweed	SB
POIL	Potamogeton illinoensis	Illinois pondweed	SB
PONCOR	Pontederia cordata	pickerel weed	EM
PONO2	Potamogeton nodosus(formerly P. americanus)	American pondweed	SB
POPE6	Potamogeton pectinatus	sago pondweed	SB

POPR5	Potamogeton praelongus	white-stemmed pondweed	SB
POPU7	Potamogeton pusillus	small pondweed	SB
PORI2	Potamogeton richardsonii	Richardson's pondweed	SB
POZO	Potamogeton zosteriformis	flat-stemmed pondweed	SB
RAFL	Ranunculus flabellaris	yellow water-cup (yellow water butt	SB
RALO2	Ranunculus longirostris(incl. R. trichophylus)	white water-cup (rigid white water b	SB
SACU	Sagittaria cuneata	Northern arrowhead	EM
SCIACU	Scirpus acutus	hardstem bulrush	EM
SCIAME	Scirpus americanus	chairmakers rush (3 square)	EM
SCIVAL	Scirpus validus	softstem bulrush	EM
SPPO	Spirodela polyrhiza	greater duckweed	NV
UNKN01	Unknown specimen No. 1		
UNKN02	Unknown specimen No. 2		
UTMA	Utricularia vulgaris(also known as U. macrorhiza)	common bladderwort	SB
VAAM3	Vallisneria americana	wild celery	SB
WO?LF	Wolffia, unidentified sp.	a watermeal sp.	NV
WOCO	Wolffia columbiana	watermeal	NV
ZAPA	Zannichellia palustris	horned pondweed	SB
ZODU	Zosterella dubia(also known as Heteranthera dubia)	water stargrass	SB

Species codes include 2006 LARE Tier I Appendix C and additional plant names added by the 6 letter species code based on the scientific name.

TIER I AQUATIC VEGETATION RECONNAISANCE SURVEY PROTOCOL

Indiana Department of Natural Resources
Division of Fish and Wildlife
402 W. Washington St. Rm W-273
Indianapolis, IN 46204

May 2006

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Tier I Reconnaissance Survey Protocol

1.0 Strategy for Surveying Aquatic Vegetation

This procedure was developed to serve as a **qualitative** surveying mechanism for aquatic plants. This protocol will serve to meet the following objectives:

1. to provide a distribution map of the aquatic plant species within a waterbody
2. to document gross changes in the extent of a particular plant bed or the relative abundance of a species within a waterbody

This survey strategy may be augmented with the Tier II Aquatic Vegetation Sampling Protocol to gain more quantitative data if desired.

1.1 Introduction to Aquatic Plant Surveying

Surveys of aquatic vegetation are important to managers and researchers for habitat inventories, diagnosis of problem areas, detection of nuisance and/or exotic species, and in the development of aquatic vegetation management plans. Many levels of surveys may be completed from visual observation to highly quantitative, repeatable strategies. The major advantage of visual qualitative survey methods is the relatively small amount of time required to complete a survey. The standardization of a reconnaissance survey procedure will allow for more precise information to be collected. This increase in precision will occur as standardization allows many people to produce more similar results over time. The methods described below are designed to provide a standard rapid assessment of aquatic plant communities within a given waterbody. The following text, tables, figures and datasheets will strive to meet the goal of standardization. A quick and easy reconnaissance protocol may increase the number of repeatable future surveys leading to a greater understanding of aquatic plant distributions and changes within the state.

1.2 Interpreting Reconnaissance Surveys

Distribution maps generated from a Reconnaissance Survey may be converted to surface area information using standard map measuring techniques (i.e., compensating polar planimeter, digital software, or scaled grids). Measurement of surface area allows for rough quantification of the information collected during the survey. These data may be compared between species, seasons, and years to allow for development of conservation and management plans. However, it is important to remember that visual measures of abundance are highly subjective and data are more valuable if subjectivity can be reduced by better defining commonly used abundance descriptions (e.g., “rare” = <2% of the community). For this reason, in water bodies with low water clarity that prevents visual identification of plant species, rake throws are conducted to allow species identification.

1.3 Habitat Stratification

The types of areas/waterbodies commonly surveyed are divided into strata and subjected to discrete surveying efforts to increase efficiency, effectiveness, and knowledge of habitat influence on plant communities. Each stratum represents a major aquatic geomorphic feature in the State of Indiana (Table 1). A few other strata are not typically surveyed. The main navigation channel on the Ohio River and other deepwater areas within selected lakes or rivers (>6 m deep) are not surveyed because aquatic vegetation is unlikely to grow in these areas in the prevailing water quality conditions. In addition, the aquatic areas near dams and/or spillways are not surveyed because of safety considerations. Refer to Table 1 when categorizing the surveyed stratum.

Table 1. Aquatic Area Strata and Codes

Stratum Description	Stratum Code
Inland Lake	IL
Inland Reservoir	IR
Lake Michigan	LM
First Order Stream	FOS
Second Order Stream	SOS
Third Order Stream	TOS
Fourth Order Stream	FROS
Fifth Order Stream	FHOS
None	NA

* When “None” is selected, describe the habitat type in the comments section of the data sheet.

2.0 Equipment

2.1 Maps

A high-resolution bathymetric map is used as the base map when available. Potential map sources also include: printouts from digital sources, USGS 7.5 minute topographic maps, aerial photos, production of a map with a stadia rod and sighting compass, or a hand drawn sketch of the lake.

2.2 Field Equipment and Explanation

A. Boat
B. Safety Equipment (e.g., life jackets)
C. Frodis (i.e., rake, anchor, or other sampling device w/ rope)
D. Lake map
E. Waterproof pens, pencils, or markers
F. Plastic bags, cooler, and gel packs for collection of unknown plants
G. Polarized sunglasses
H. Secchi disk (optional)
I. Range finder (optional)
J. GPS unit (WAAS enabled)
K. Depth detection device (e.g., sounding line, depth gun, sonar; optional)
L. Aquaview (looking glass; optional)

A boat or canoe is needed to survey the lake. Any safety equipment that is required by law (U.S. Coast Guard or state law) should also be carried on board. A frodis is often needed to collect plants from deeper water areas and below canopies when visual inspection does not allow species determination. The lake map is marked with plant bed numbers and approximate boundaries to help distinguish plant beds of different species and/or groups of species within the lake. A unique datasheet will correspond to each plant bed number on the map for further explanation of that particular plant community. A Secchi disk will help determine the depth at which plants can be seen and will help define the littoral region. A range finder is helpful in determining distances from shore to more accurately map vegetation. WAAS-enabled GPS units should be used to determine locations of plant beds and perimeters of plant beds using tracks and/or waypoints. Coordinates may be uploaded to computers to map vegetation beds for permanent record and help in the determination of surface area of vegetation. Coordinates may also be plotted on scaled maps using map grids. A depth detection device may be used to determine the extent of the littoral region including shallow shoals offshore where aquatic vegetation may grow. Some sonar device models may also help determine the maximum depth of macrophyte growth. A looking glass may be used to more clearly see vegetation below the surface. Polarized sunglasses are a necessity as they greatly improve one's ability to see below the surface and distinguish plants, thus reducing the number of rake tosses that are needed. Finally, plastic bags are on hand for the collection of unidentified species.

3. Preparation

3.1 Pre-survey Information

Prior to entering the field, information should be gathered on the lake being surveyed. Valuable information includes lake size, maximum depth, historical species lists (if available), and historical Secchi depth data. Sources for this information include the Indiana Department of Natural Resources' regional fisheries biologists, diagnostic study reports, websites (IDNR, IDEM, & IU), and other sources. The size and depth of the lake can help determine equipment needs and the amount of time needed to complete a survey of the lake. While survey time is often correlated to lake size, it is more closely related to the shoreline length and/or area of the littoral zone (i.e., large lakes with many coves have a greater shoreline length). **The acceptable sampling period extends from 15 June to 15 September. If resources are limited to a single reconnaissance survey, then the surveys should be conducted between 15 July and 31 August;** however, secondary surveys are recommended to catch temporal variations in plant communities. Also, depending on the intent of the survey, some *partial* lake surveys may be conducted.

3.2 Determination of Littoral Zone

The entire littoral zone of a lake should be briefly examined during a Reconnaissance Survey. Determination of the littoral zone is important for management and mapping of vegetative cover within a lake. The littoral zone is defined as the region of a lake from shore to a depth where vegetation disappears. In lakes with relatively shallow secchi depths the 1% light level may be approximated by multiplying the secchi depth by a factor of three. Most macrophyte species will not grow to the 1% light level, only algae and primitive plants. In extremely clear lakes macrophytes are generally restricted by hydrostatic pressure, rather than light, to a depth of 6 m (19.7 ft.) but some species may grow deeper. Eurasian watermilfoil has been found to grow to a depth of at least 9 m (30 ft.) while elodea has been found growing to a depth of 12 m. Isoetes (quillwort) has been found to grow to a depth of 15 m (~50 ft.) or more in clear lakes.

Secchi depth should be measured as follows:

A. Anchor the boat to prevent drifting. Be careful not to disturb the sediments on the bottom when anchoring since this could cloud the water and interfere with the Secchi disk reading, especially in shallow lakes.

B. Once you are at the deepest point of the lake, go to the shady side of the boat and if you are wearing sunglasses, remove them.

C. Lower the Secchi disk (8-inch type) straight down into the water until the disk just disappears from sight. Mark the rope at the water level with a clothespin.

D. Slowly raise the disk up until it reappears. Mark the rope at the water level with your fingers or with the other clothespin.

E. To find the Secchi depth, grasp both clothespins in one hand and find the center of the loop of rope. Move one clothespin to that point and remove the other. This point is one-half the distance between the point of disappearance of the disk and the point where it re-appeared. Measure the distance from this point to the surface using a measuring tape.

F. Record the Secchi depth on your data sheet to the nearest tenth of a foot.

The littoral zone of a lake, for purposes of a standard Reconnaissance Survey, is defined as the area from the shoreline to a depth equal to three times the known (or average) Secchi depths.

4. Surveying

4.1 Survey Coverage

Once the littoral zone of a lake has been determined, the survey can begin. The boat path should include a zig-zag pattern through the littoral region of the lake. Lakes that drop off quickly may only need one path along shore. In areas where the littoral region extends far from shore, several passes may need to be made in a zig-zag pattern. **These passes should never be farther apart than can be visually inspected.** For instance, if a bed of vegetation extends to the surface and it is visible from one side to the other, there is no need to make multiple passes through this area. However, in areas of dense canopies an effort is made to determine if any species are growing below the canopy. (This may include one to a few rake tosses.) Each unique plant bed requires a unique datasheet to be completed (see Appendix A). Any off-shore shoal areas that have a depth less than the maximum littoral zone depth are surveyed as well (an additional datasheet compiled for each). A photocopy of a bathymetric map for the lake with potential littoral areas outlined will be useful during field surveys to ensure that no areas are missed. A cover datasheet is completed for the waterbody as a whole and all individual plant bed datasheets are then attached to the waterbody coversheet.

Once approximately 50% of the shoreline areas are surveyed, a determination is made on the detail needed to survey within the remainder of the littoral region. It is important to sample areas that provide different habitat for plants (e.g., points, coves, shores with different features). Different shorelines attributes (e.g., face north, south, etc.) often contain different species (e.g., plants that sprout from fragments will often be more abundant on the windward side of a lake). In a lake with many species growing in relatively small beds, the littoral zone is examined more carefully than a lake with dense monoculture stands that cover large areas.

The time associated with a survey varies based upon factors noted above and the experience of the survey team. As much detail is collected as time allows. In general, most surveys completed using this protocol will take anywhere from three to eight hours to complete. The amount of time required is affected by the diversity of the plant beds and the amount of littoral region, more so than the lake size. Shoreline length also greatly affects the time needed to complete a Reconnaissance Survey. Generally, one to two miles of shoreline can be surveyed per hour. However, if the littoral region is narrow and/or diversity is low, a greater distance is surveyed per hour. Lakes less than 300 acres require approximately 2 hours per 100 acres. Lakes greater than 300 acres generally decrease in the time required per 100 acres. Lakes as large as 800 acres may be completed in one day. It is important to gather and review lake maps ahead of time since they provide the survey team with valuable information related to depth contours, shoreline length, and lake size; thus, allowing the team to devote an appropriate amount of time to the survey.

4.2 Vegetation Mapping & Data Recording

The survey technique utilizes a combination of intense visual examination and limited rake grabs to identify the abundance of aquatic species in individual plant beds. The individual plant bed survey area is defined as a contiguous, consistent (similar composition) community. This survey site/bed is then surveyed in its entirety. If the community composition changes dramatically while surveying what appears to be a contiguous bed, prepare individual datasheets for the different communities and note their approximate boundaries on the attached map.

A cover sheet is completed for each waterbody. Individual site data sheets for a given plant bed are then attached to the waterbody cover sheet. <u>A new site data sheet is started for each plant bed in the waterbody.</u> The survey sites/beds are numbered counter-clockwise around the waterbody beginning with "01", and remain the same from year to year (as much as possible). <u>Information about each plant bed appears in its entirety on a single page.</u> When there is not enough room remaining on a page to complete the listing for a bed, a new page is started. **All numbered survey sites/beds have approximate boundaries sketched on a corresponding map and labeled with their unique number, such as "01".**

The data sheet (Appendix A) is divided into four sections, **Site information**, **Site Coordinates**, **Species information**, and **Reminder information**. The **Reminder information** contains the data choices to be entered in the major data fields (boxes). All data fields on the data sheet are explained in detail in Appendix B.

The surveying operation is composed of multiple steps, beginning with recording **Species information**. Steps 1–4 are to collect **Species information.** Steps 5–8 are to complete **Site information and Site Coordinate information**.

Step 1. After a survey site/bed is reached, a site number, such as "01", is recorded in the **Plant Bed ID** box of the **Site Information** section. This step signifies the beginning of the **Species Information** section. Travel in zig-zag pattern through the plant bed (See Figure 1). Record the species code (Appendix C) for all species in the **Species code** box and assign a visual abundance rating (in the **Abundance** box) for every submersed, rooted floating-leaved, non-rooted floating-leaved, emergent species, and alga observed. Assign abundance ratings based on the increments outlined in Table 2. These ratings essentially represent a percent cover measurement. If the canopy is dense or visibility is too poor for accurate visual identification of species, make sufficient rake throws to determine the occurrence of all species.

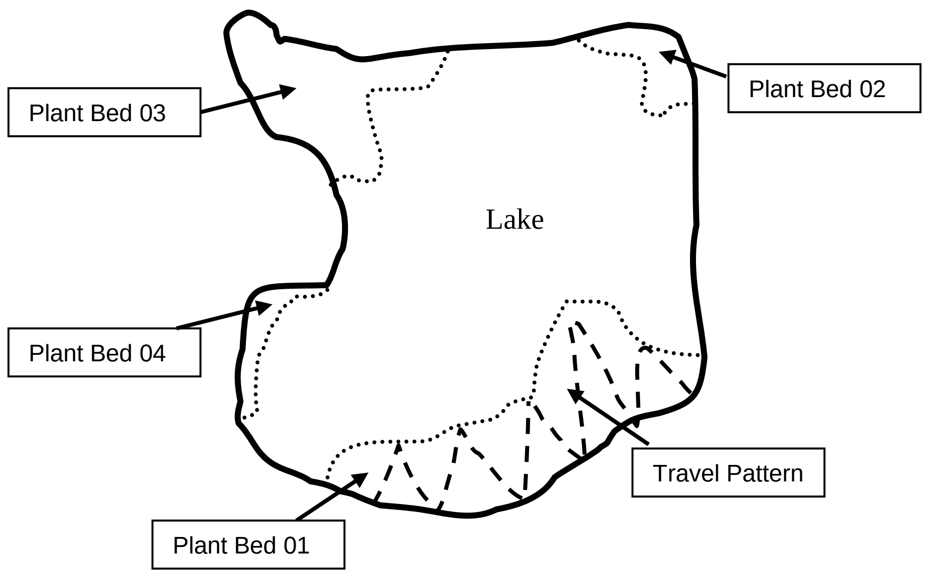


Figure 1: Depicts a potential travel path around a lake for purposes of a Reconnaissance Survey.

Table 2. Visual Abundance Ratings

Abundance (%)	Cover rating
> 61	4
21-60	3
2-20	2
< 2	1

Step 2. If the choice of species code fits the definition in Appendix B, assign a QE code of “0”. Otherwise, assign a code according to Table 3 in the **QE** box to flag each uncertain choice of species code. **Voucher specimens are collected for any species of which the identity is uncertain or unknown, or a species that is known not to be in the state herbarium.**

Table 3. Plant identification quality evaluation codes

Identification certainty	*QE* code
Species code follows the definition in Appendix B	0
Genus certain, species suspected	1
Both genus and species suspected	2
unknown	3

Step 3. If a specimen is collected, a 1 is recorded in the **Voucher** box otherwise a “0” is recorded. If the specimen is sent to a taxonomist for identification, the 1 is later amended to a 2 to serve as a reminder that identification is pending. Comments about that site (unusual situations, species taken for identification or the presence of endangered, threatened, or rare (ETR) species) are written in the **Comments** section by the data recorder. If available the latitude and longitude location of any voucher specimens collected or the location of ETR species is also recorded in the comments sections. Voucher specimens should include multiple specimens of the same species (3-5 specimens with all available morphological characteristics, flowers, fruits, etc.)

Step 4. After reaching the perimeter of the plant bed, sketch the relative size and location of the individual bed on an attached lake map. <u>Record the corresponding **Plant Bed ID** number on the map.</u> It is also possible to assign a unique reference number/letter to denote the approximate location of a species of special interest on the map. Record this number/letter on both the map and the data sheet (**Ref. ID** box).

The area of the plant bed may be drawn onto the map with some accuracy if shoreline points of reference (e.g., points, docks, etc.) are used to determine your location on the lake. GPS units and rangefinders may also increase the accuracy of these sketches.

Step 5. After having surveyed the extent and composition of the plant bed, visually estimate by life form the percentage canopy cover of nonrooted floating-leaved, rooted floating-leaved, emergent, and submersed <u>canopy</u> species in the bed. Rate the percentage cover of the canopy species according to Table 4, and record the ratings in the appropriate **Canopy** box. (Note: Emergent, rooted floating-leaved, and nonrooted floating-leaved plants intercept sunlight at or above the water surface and may shade submersed plants growing in the water column, therefore, the percent canopy is important site information.) The rating should reflect the abundance of these life forms throughout the entire plant bed and serve to summarize the canopy cover and composition for the bed.

Table 4. Vegetation Canopy Ratings

Cover (%)	Cover rating
> 61	4
21-60	3
2-20	2
< 2	1
None	0

Step 6. For those plant beds where invasive species are present, rake throw sampling should be conducted to quantify the degree of infestation. The number of rake throws required depends upon the homogeneity of the plant bed. In plant beds highly dominated by one species, as few as three throws may be sufficient if the results are the same each throw. Alternatively if each rake throw has plant species compositions that vary, then a larger number of rake throws will be required (e.g., 4-5 throws).

Step 7. Record the number of rows with information (from the **Species information** area) in the **Total # of Species** box at the top of the data sheet.

Step 8. Return to the approximate center of the plant bed and record GPS derived latitude and longitude coordinates and record the coordinates in the **Site coordinates** area of the data sheet. (A map grid may also be used to determine latitude and longitude coordinates if GPS is not available.) If appropriate, also record the GPS derived latitude and longitude coordinates for the location that defines the furthest lakeward extent of the plant bed. Note the approximate locations of both points with an "X" on the attached plant bed map.

Step 9. Repeat steps 1 to 8 for each plant bed surveyed. Remember to start a new data sheet for each new bed encountered.

5. Post Survey Analysis

All waterbody summary information and GPS metadata is recorded on the **Waterbody cover sheet.** Datasheets are completed to the greatest extent possible following the survey. The map is completed with all relevant information and plant beds drawn. The surface area (acres) of each plant bed is determined and recorded in the **Bed Size** box on the data sheet. When gross historical changes in species composition, dominant species, and surface coverage are observed from year to year, notes are added to the **Comments** section.

6. Data & Equipment Management

All data sheets are identified with the sampling organization's name and crew leader and recorder names. Photocopies are made of all data and log sheets. The photocopied data sheets are mailed to the Department of Natural Resources Division of Fish & Wildlife. All originals are retained by the sampling organization.

Endangered, threatened or rare species are recorded on the data sheet and approximate locations noted on the map through the use of the **Reference ID** box (See Step 4). The presence of such species should also be recorded on the Indiana Special Plant Survey Form (See Appendix A) and sent to the IDNR Division of Nature Preserves.

Voucher specimens are collected and directed to the attention of Dr. Robin Scribailo at Purdue-North Central.

To avoid the spread of exotic species, survey crews should insure that all traces of aquatic vegetation are removed from boats, motors, and sampling gear before surveying other lakes/streams.

7. References Cited

IDNR. 2004. Procedure manual for Tier II aquatic vegetation surveying. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, Indiana. 10p.

Yin, Y., Winkelman, J.S., and H.A. Langrehr. 2000. Long Term Monitoring Program procedures: Aquatic vegetation monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, LTRMP 95-P002-7. 8pp. + Appendices A-C.

APPENDICES

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization:

Waterbody Name: Lake ID:

County: Date:

Habitat Stratum: Ave. Lake Depth (ft): Lake Level:

GPS Metadata

Crew Leader:

Datum: Zone: Accuracy:

Recorder: Method:

Secchi Depth (ft): Total # of Plant Beds Surveyed: Total # of Species:

Littoral Zone Size (acres):

- ❑ Measured
- ❑ Estimated

Littoral Zone Max. Depth (ft):

- ❑ Measured
- ❑ Estimate (historical Secchi)
- ❑ Estimated (current Secchi)

Notable Conditions:

Aquatic Vegetation Plant Bed Data Sheet

Page ___ of ___

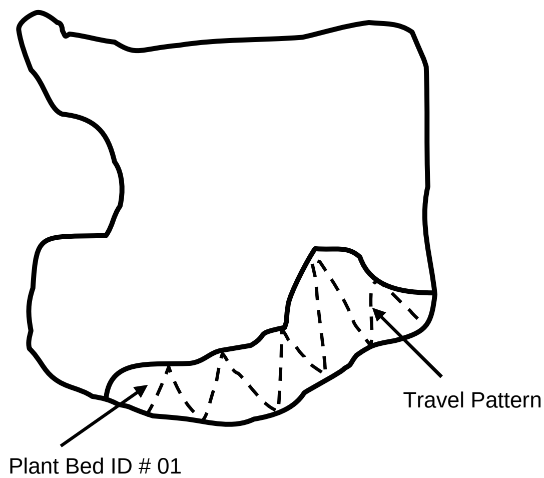
State of Indiana Department of Natural Resources

ORGANIZATION:					**DATE:**	
SITE INFORMATION					**SITE COORDINATES**	
Plant Bed ID:	Waterbody Name:				Center of the Bed	
Bed Size:					Latitude:	
Substrate:	Waterbody ID:				Longitude:	
Marl?	Total # of Species				Max. Lakeward Extent of Bed	
High Organic?	**CanopyAbundance at Site**				Latitude:	
	S:	N:	F:	E:	Longitude:	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or
letter to denote specific
location of a species;
referenced on attached map

Quad Code:_____________

Indiana Special Plant Survey Form

Element Name: ____

Surveyor (s): ______________________________Date: ______ Time: ____ to _______

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____T ____R ____ Quad name: _________

Repeat visit: Yes No   Repeat visit needed: Yes No   When: ______________

EO boundaries mapped: Yes No   County: ________________________________

Area name (if applicable) ____

Biology

Phenology	Approx # Indiv	Population Area	Age Class
__In leaf	__ 1-10	__ 1 yd^2	__ % Seedlings
__In bud	__ 11-50	__1-5 yd^2	__% Immature
__In flower	__ 51-100	__5-10 yd^2	__% 1st year
__In fruit	__101-1000	__10-100 yd^2	__% Mature
__Seed Dispersing	__ 1001-10,000	__100 yd^2-2 ac	__%Senescent
__Dormant	__10,001+	__2 ac +	

Comments on above: ____

Compared to your last visit to this site:	Approx # Indiv	Population Area	Age Class
	__more	__more	__same
	__same	__same	__diff
	__less	__less	

Reproduction Is reproduction occurring?__ Type: __sexual, __asexual, __both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution __ solitary, __clumps or dense groups, __small patches or cushions __small colonies or large carpets, __large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, 3) normal, 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships:

Habitat

Aspect	Slope	Light	Topographic Position	Moisture
__N	__Flat	__Open	__Crest	__Inundated (Hydric)
__E	__0-10’	__Filtered	__Upper slope	__Saturated(Wet-mesic)
__S	__10-35’	__Shade	__Mid-Slope	__Moist (Mesic)
__W	__35’ +		__Lower slope	__Dry (Xeric)
	__Vertical		__Bottom	

Elevation: ______ft to _______ft. Surface Relief: ___/: ___∪:___∩:___—:___~~

Substrate/Soils: ____

Associated Natural Community/Plant Community: ______________________

List other members of this genus co-occurring at this site: __________________

Characteristic associated species: ___________________________________

____

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

Ownership info: (if known) ____

NOTE: Collect specimen if a healthy, viable population exists. Collection # ____________

Appendix B.

Explanations of Fields on the Aquatic Vegetation
Waterbody Cover Sheet

Surveying Organization	Name of agency, corporation, group, individual, etc. that is collecting the data
Waterbody name	Common name of the lake or stream. Name should be consistent with the name found on most maps of the given waterbody (e.g. Lake Lemon, not Lemon Lake).
Lake ID	Unique State assigned alphanumeric code for the specific waterbody. Available through IDNR, Division of Fish & Wildlife.
County(s)	Name of the county(s) where sampling was conducted. When the waterbody or stream section traverses more than one county, list the primary county (county with the greatest acreage of water) first.
Date	The month (MM), day (DD), and year (YYYY) on which a site was sampled. Zeros (0) must be written in so that the date has eight digits.
Habitat stratum	Each stratum code defines a unique, major aquatic geomorphic feature in the state of Indiana. The habitat stratum of the site according to the above protocol is an important ecological consideration, as well as, valuable for the purposes of stratifying future sampling. The letter codes are listed in Table 1.
Average Depth	Average depth of the lake. Reference bathymetric maps, state personnel, historic studies etc.
Lake Level	Lake level at the time of sampling
Crew leader code	The full name or ID number that uniquely identifies the individual responsible for certifying that the samples and the data on the form were collected in compliance with current protocol and are, to the best of their knowledge, complete and free of errors. This identifying field underscores the importance of above method and is an important chain-of-custody procedure.
Recorder code	A name or number or initials that uniquely identifies the individual recording the data on the data sheets.
Datum	One or more constants used for calculating positions or elevations. These series of constants are commonly referred to as NAD’83, NAD’27, WGS’84, etc.
Zone	The number that identifies the correct grid from which the coordinates were taken. All of the State of Indiana falls into Zone 16.

Accuracy	The GPS measure of possible error related to the geometry of satellites. This number value is recorded when the Lat/Long coordinates are recorded. The method field indicates whether the scale is PDOP (Percent dilution of precision) or FOM (Figure of Merit).
Method	A code that identifies the method used to locate the site and the type of accuracy measurement used by the equipment. B = Base Map D = GPS with differential corrections and PDOP G = GPS without differential corrections and PDOP F = GPS with differential corrections and FOM X = GPS without differential corrections and FOM O = other (explain)
Secchi Depth	Secchi depth is taken and recorded (feet) at a mid plant bed site as soon as depth allows and distance from shore is deemed appropriate.
Total # of Plant Beds	Number of plant beds surveyed on the particular lake/stream as part of this sampling effort.
Total # of Species	The total number of <u>unique</u> records (rows) in **SPECIES INFORMATION** on the data sheets from <u>all beds</u>. This number represents the species diversity for the entire waterbody.
Littoral Zone Size	Size (acres) of the entire littoral zone may be measured through a variety of mapping techniques or estimated by the surveyors. The method is then noted.
Littoral Zone Max. Depth	Maximum littoral depth may be measured at a variety of locations in the field and averaged <u>or</u> estimated through the use of current or historical Secchi disk data. The extent of the littoral zone can be determined by multiplying the average or current Secchi depth by three. The method is then noted.
Notable Conditions	Comments that describe any unusual weather or water quality conditions that may interfere with accurate sampling such as rain, strong winds, algal blooms, etc.

Appendix B. Explanations of Fields on the Aquatic Vegetation
Plant Bed Data Sheet

Organization name	Name of agency, corporation, group, individual, etc. that is collecting the data
Date	The month (MM), day (DD), and year (YYYY) on which a site was sampled. Zeros (0) must be written in so that the date has eight digits.

SITE INFORMATION

Waterbody name	Common name of the lake or stream. Name should be consistent with the name found on most maps of the given waterbody (e.g. Lake Lemon, not Lemon Lake).
Waterbody ID	Unique State assigned alphanumeric code for the specific waterbody. Available through IDNR, Division of Fish & Wildlife.
Plant Bed ID	Two-digit number assigned to uniquely identify each bed/site. Accuracy of the Plant Bed ID is critical because it links field data to be collected with data already available in the database. A zero must be written before the number so the ID # is a two-digit number starting with “01”.
Substrate	A qualitative code assigned to substrate type following tactile and visual examination of sediment at the sampling site. Substrate is rated on a scale of 1 to 6 according to Table 5.
Marl	A “1" identifies the presence of a marl (calcium carbonate) sediment. The default is a “0”.
High Organic	A “1" identifies the presence of coarse organic material in the sediment. The default is a “0”.
Total # of Species	The total number of detail records (rows) in **SPECIES INFORMATION** that contain data on this particular data sheet.
Cover	S = Percent canopy abundance of all submersed ‘topped-out’ species combined for the bed using the ratings described in Table 4. N = Percent canopy abundance of all nonrooted floating-leaved species combined for the bed using the ratings described in Table 4. F = Percent canopy abundance of all rooted floating-leaved species combined for the bed using the ratings described in Table 4. E = Percent canopy abundance of all emergent species combined for the bed using the ratings described in Table 4.

SITE COORDINATES (Recorded when the approximate center of the plant bed is determined and the furthest lakeward extent is known.)

Latitude — The latitude coordinate for the site (either center or extent). The coordinate is recorded via a GPS unit after plant bed boundaries are estimated.

Longitude — The longitude coordinate for the site (either center or extent). The coordinate is recorded via a GPS unit after plant bed boundaries are estimated.

SPECIES INFORMATION

Species code — The alphanumeric six letter code for a species. Most of the species codes are available in Appendix C. If the genus of a plant is known and species unknown, then a new code is made up with the first four letters of the genus name and a '?' (question mark) inserted between the second and third letters. For examples, "PO?TA "for *Potamogeton* sp., and "MY?RI" for *Myriophyllum* sp. Using the species code of a suspected species is preferable, however, when based on the suggestion of the vegetation specialist. The confidence level of identification will be reflected in the **QE** code.

Abundance — A number (1-4) that represents the percent abundance of a particular species in the community at the bed/site using the ratings described in Table 2.

QE — A number (0–3) used to flag the taxonomic identification uncertainty (Table 3).

Voucher — A code denoting whether a voucher specimen was taken of the species.
0 = no voucher taken
1 = voucher taken, and not sent out for identification
2 = voucher taken, and sent out for identification

Reference ID — A number or letter that denotes a specifics location of a species of concern. The number or letter is referenced on an attached map showing the approximate location(s).

Comments — A field for recording weather (e.g., overcast, rain, sunny) and any additional observations. Limit comments to 100 characters.

Reminder Information (Abbreviated glossary of codes used in the data fields.)

Appendix C. Species Codes

Species Code	**Scientific Name**	**Common Name**	**Vegetation Type**
ALGA	Any species of filamentous alga (incl. Spyrogyra, Cladophora, Hydrodictyon)	algae	NV
AZ?OL	*Azolla* sp.	a mosquito fern sp.	NV
AZCA	*Azolla caroliana*	Carolina mosquito fern	NV
AZME	*Azolla mexicana*	Mexican mosquito fern	NV
CACA	*Cabomba caroliniana*	fanwort	
CEDE4	*Ceratophyllum demersum*	coontail	SB
CH?AR	*Chara* sp.	a chara sp.	SB
CHAS	Chara aspera		SB
CHBR	Chara braunii		SB
CHBR2	Chara brittonii		SB
CHCO	Chara contraria		SB
ELCA7	*Elodea canadensis*	Canadian waterweed	SB
ELNU2	*Elodea nuttalli*	western waterweed	SB
LEMN	Species within the Lemnaceae	duckweeds	NV
LEMI3	*Lemna minor*	small or common duckweed	NV
LETR	*Lemna trisulca*	star duckweed	NV
LUDE4	*Ludwigia decurrens*	primrose-willow	FL
LVWORT	*Riccia* sp., *Ricciocarpus* sp.	a liverwort species	NV
MYSI	*Myriophyllum sibiricum*	northern watermilfoil	SB
MYSP2	*Myriophyllum spicatum*	Eurasian watermilfoil	SB
MY?RI	*Myriophyllum*, unidentified species	a watermilfoil sp.	SB
NAFL	*Najas flexilis*	slender naiad	SB
NAGR	*Najas gracillima*	slender waternymph	SB
NAGU	*Najas guadalupensis*	southern waternymph	SB
NAMI	*Najas minor*	brittle waternymph	SB
	Potamogeton foliosus, *P. pusillus*,		

NLPW	or other unidentified narrow-leaved pondweeds	narrow-leaved pondweeds	SB
NELU	*Nelumbo lutea*	American lotus	FL
NI?TE	*Nitella* sp.	a nitella sp.	SB
NOAQVG		no aquatic vegetation in site	NV
NULU	*Nuphar variegetum* (formerly N. luteum)	yellow pond lily	FL
NYTU	*Nymphaea tuberosa*	white water lily	FL
POAL8	*Potamogeton alpinus*	red or alpine pondweed	SB
POCR3	*Potamogeton crispus*	curly-leaf pondweed	SB
POEP2	*Potamogeton epihydrus*	ribbon-leaf pondweed	SB
POFO3	*Potamogeton foliosus*	leafy pondweed	SB
POGR8	*Potamogeton gramineus*	variable pondweed	SB
POIL	*Potamogeton illinoensis*	Illinois pondweed	SB
PONO2	*Potamogeton nodosus* (formerly *P. americanus*)	American pondweed	SB
POPE6	*Potamogeton pectinatus*	sago pondweed	SB
POPR5	*Potamogeton praelongus*	white-stemmed pondweed	SB
POPU7	*Potamogeton pusillus*	small pondweed	SB
PORI2	*Potamogeton richardsonii*	Richardson's pondweed	SB
POZO	*Potamogeton zosteriformis*	flat-stemmed pondweed	SB
RAFL	*Ranunculus flabellaris*	yellow water-cup (yellow water buttercup)	SB
RALO2	*Ranunculus longirostris* (incl. *R. trichophylus*)	white water-cup (rigid white water buttercup)	SB
SACU	*Sagittaria cuneata*	Northern arrowhead	
SPPO	*Spirodela polyrhiza*	greater duckweed	NV
UNKN01		Unknown specimen No. 1	
UNKN02		Unknown specimen No. 2	
UTMA	*Utricularia vulgaris* (also known	common bladderwort	SB

	as *U. macrorhiza*)		
VAAM3	*Vallisneria americana*	wild celery	SB
WO?LF	*Wolffia*, unidentified sp.	a watermeal sp.	NV
WOCO	*Wolffia columbiana*	watermeal	NV
ZAPA	*Zannichellia palustris*	horned pondweed	SB
ZODU	*Zosterella dubia* (also known as *Heteranthera dubia*)	water stargrass	SB

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek Consulting

Waterbody Name: Big Lake

Lake ID:

County: NOBLE

Date: 08/01/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 25'

Lake Level: 898
-5-8" LOW

GPS Metadata

Crew Leader: B. NEILSON

Datum: NAD 83

Zone: 16

Accuracy: PDOP

Recorder: B. NEILSON

Method: D

Secchi Depth (ft): 3.5

Total # of Plant Beds Surveyed: 6

Total # of Species: 17

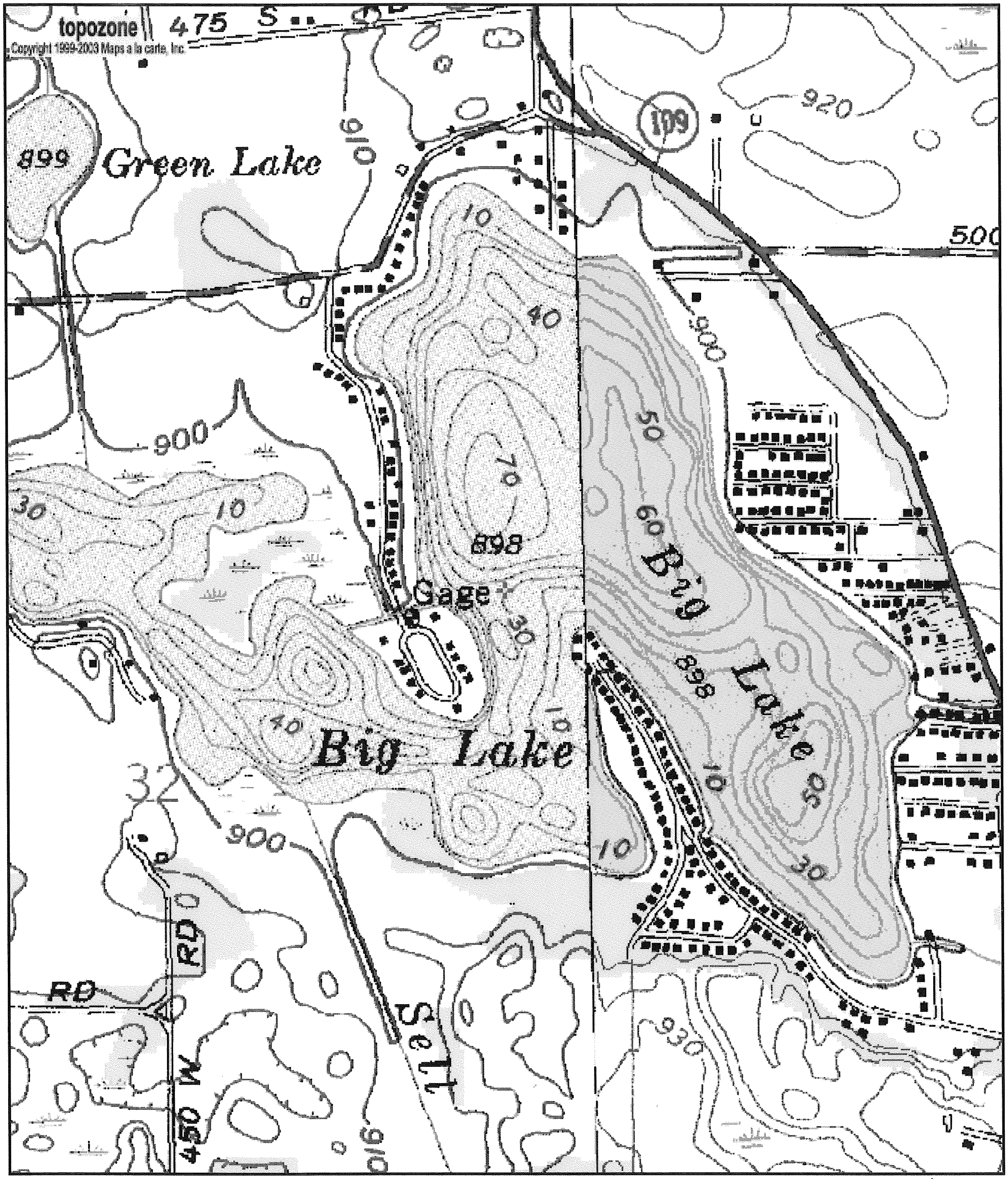
Littoral Zone Size (acres): 32.1

- ☒ Measured
- ☐ Estimated

Littoral Zone Max. Depth (ft): 11'

- ☐ Measured
- ☒ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions: LOW RAINFALL THROUGHOUT SUMMER
LAKE IS 5-8" BELOW SPILLWAY.



UTM 16 625495E 4570231N (NAD27)

USGS Ormas (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

204.4 acres

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 6

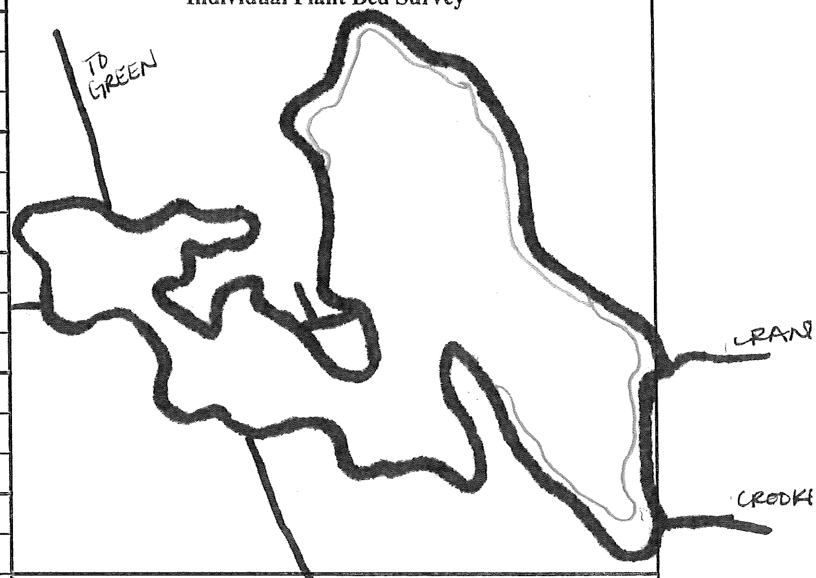
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 01	Waterbody Name: Big Lake	Center of the Bed	
Bed Size:		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 14	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude:	41° 16' 37.47" N
	S: 3 N: 1 F: 2 E: 2	Longitude:	85° 29' 49.79" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3	0	0	
TYPSPP	1	0	0	
ALGA	1	0	0	
NYTU	1	0	0	
VAAM3	3	0	0	
CH?AR	1	0	0	
CEDE4	3	0	0	
SCIVAL	1	0	0	
POPE6	1	0	0	
MYSP2	2	0	0	
POCR3	1	0	0	
NAFL	2	0	0	
PONCOR	1	0	0	
SACH	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 6

State of Indiana Department of Natural Resources

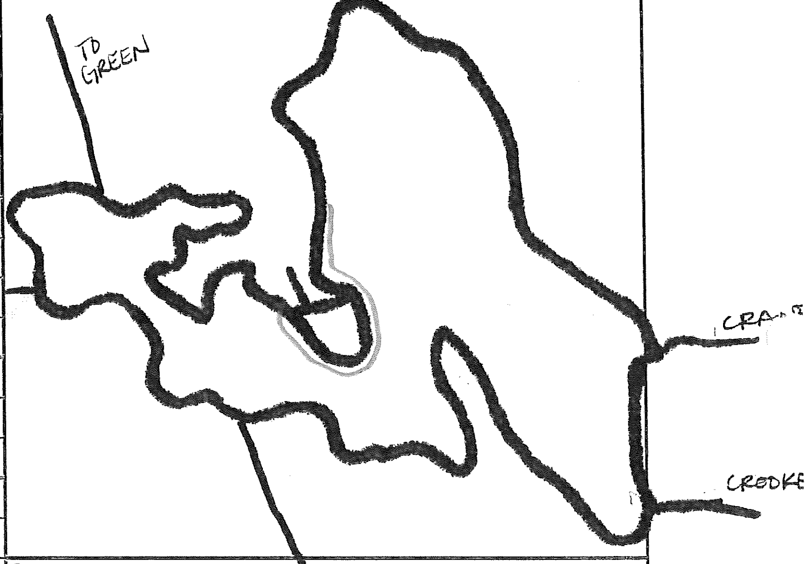
ORGANIZATION: Williams Creek		DATE:	08/01/2007

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 02	Waterbody Name: Big Lake	Center of the Bed
Bed Size:		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species	Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 16' 25.04" N
	S: 4 N: 1 F: 1 E: 1	Longitude: 85° 30' 10.79" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYPSPP	2	0	0	
SCIVAL	1			
ALGA	1			
CEDE4	3			
VAAM3	3			
NAFL	1			
POCR3	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 6

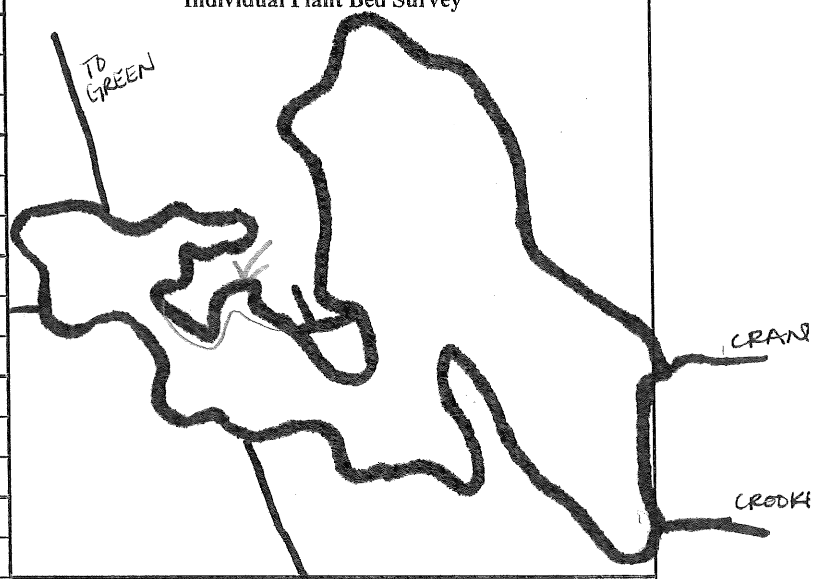
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 03	Waterbody Name: Big Lake	Center of the Bed	
Bed Size:		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 10	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude:	41° 16' 33.09" N
	S: 3 N: 1 F: 1 E: 3	Longitude:	85° 30' 21.61" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	2			
NULU	3			
MYSP2	2			
VAAM3	2			
ALGA	1			
TYP.SPP	3			
POCR3	1			
LYTSAL	1			
DECVER	2			
CEDE4	3			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 6

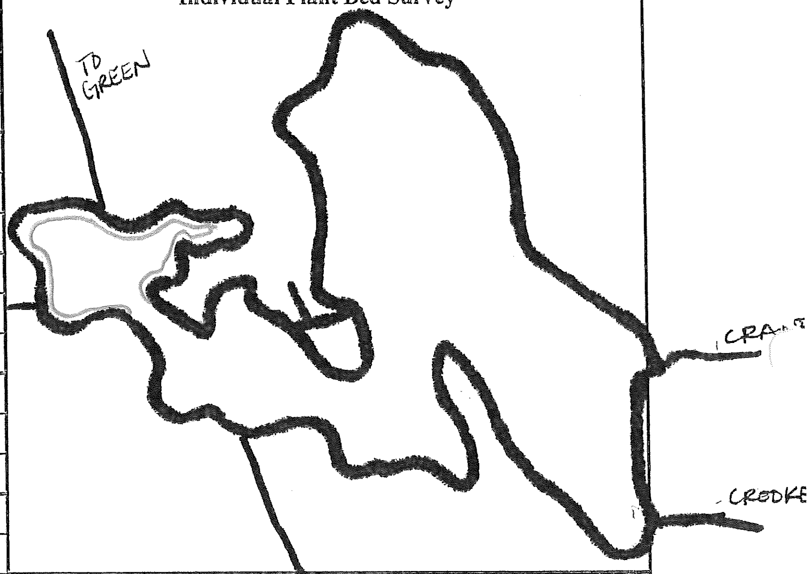
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 04	Waterbody Name: Big Lake	Center of the Bed	
Bed Size:		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 13	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude:	41° 16' 39.58" N
	S: 3 N: 1 F: 3 E: 3	Longitude:	85° 30' 36.82" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	2	0	0	
NULU	3			
MYSP2	1			
VAAM3	2			
ALGA	1			
POCR3	1			
DECVER	2			
LEMI3	1			
TYPSPP	3			
CEDE4	3			
NAFL	1			
POPE6	1			
CH3AR	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 6

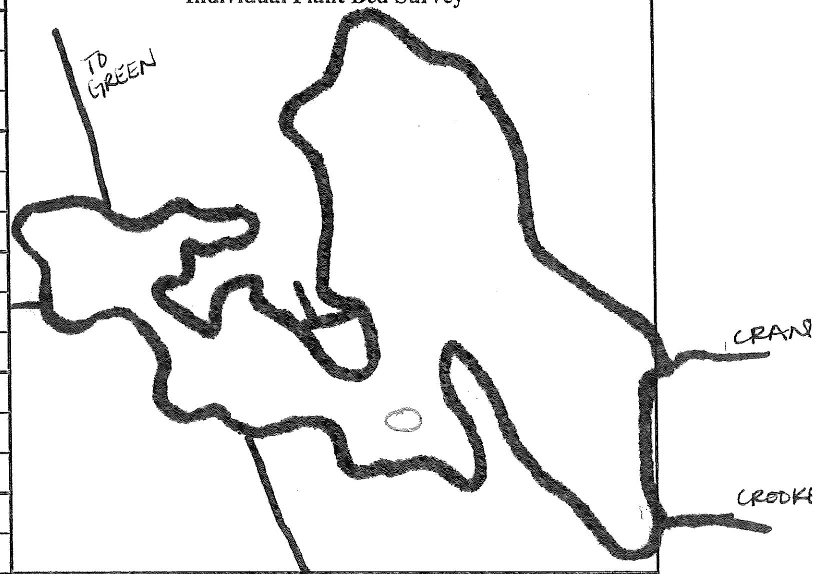
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		SITE COORDINATES	
Plant Bed ID: 05	Waterbody Name: Big Lake	Center of the Bed	
Bed Size:		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 5	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude:	41° 16' 20.51" N
	S: 3 N: 1 F: 3 E:	Longitude:	85° 30' 04.19" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
CEDE4	3			
MYSP2	2			
POCR3	1			
ALGA	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 6

State of Indiana Department of Natural Resources

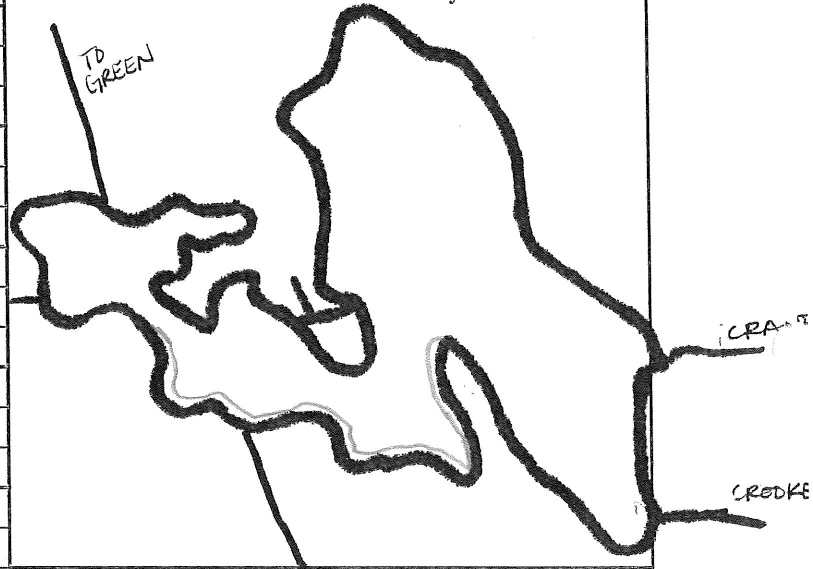
ORGANIZATION: Williams Creek		DATE:	08/01/2007

SITE INFORMATION						SITE COORDINATES	
Plant Bed ID: 06	Waterbody Name: Big Lake					Center of the Bed	
Bed Size:						Latitude:	
Substrate: 2	Waterbody ID:					Longitude:	
Marl? 0	Total # of Species 10					Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site					Latitude:	41° 16' 18.37" N
	S: 2	N: 1	F: 3	E: 3		Longitude:	85° 30' 03.45" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYPSPP	3	0	6	
NYTU	3	|	|	
NULU	3	|	|	
CH?RA	2	|	|	
POCR3	2	|	|	
MYSP2	2	|	|	
ALGA	1	|	|	
DECVER	2	|	|	
POPE6	2	|	|	
VAAM3	2	↓	↓	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: Crane Lake

Lake ID: —

County: NOBLE

Date: 08/09/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 13'

Lake Level: 899

GPS Metadata

Crew Leader: B. NEILSON

Datum: NAD 83

Zone: 16N

Accuracy: PDOP

Recorder: B. NEILSON

Method: D

Secchi Depth (ft): 4

Total # of Plant Beds Surveyed: 2

Total # of Species: 14

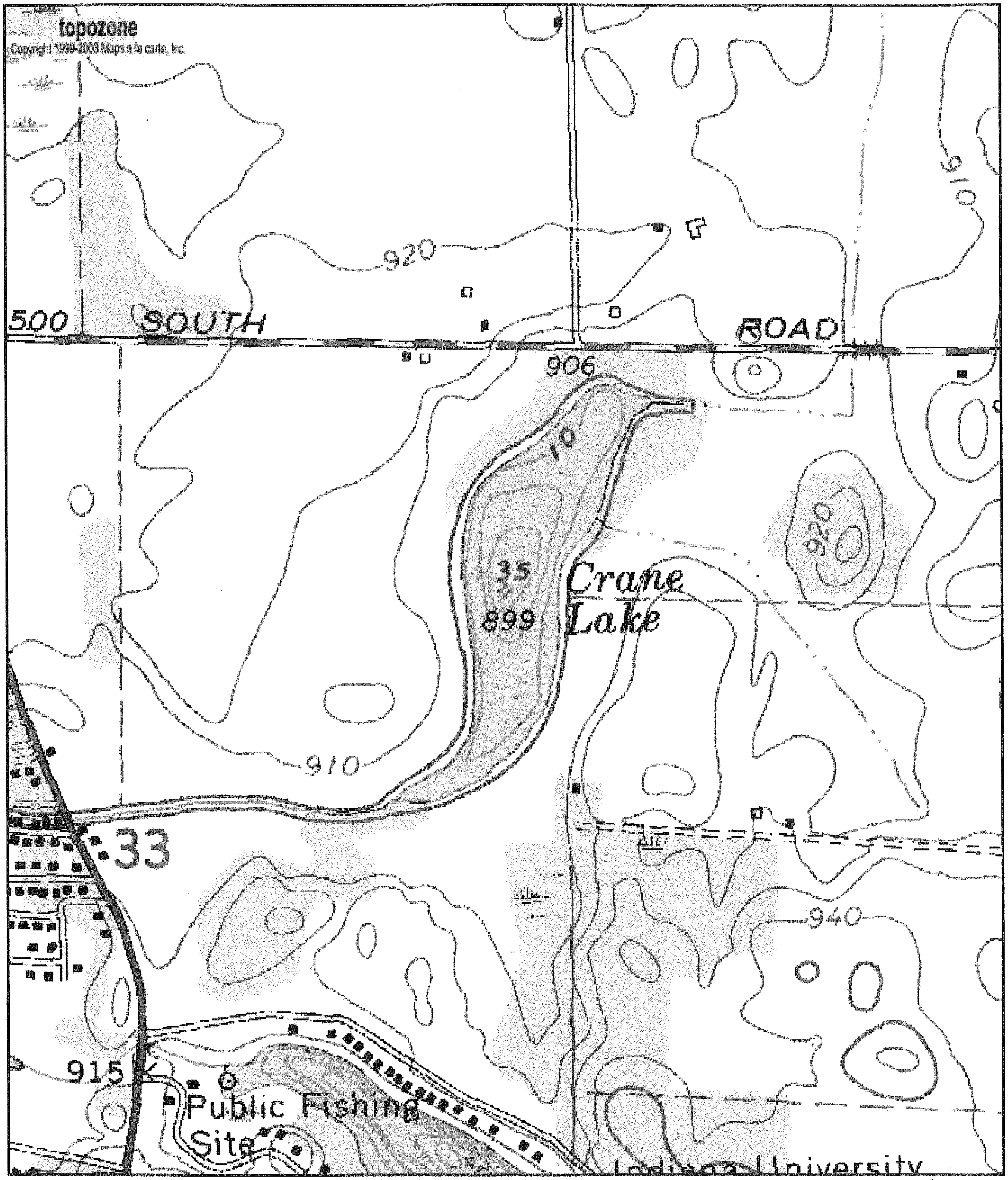
Littoral Zone Size (acres): 6.9

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 12

- ☐ Measured
- ☒ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:



26.2 acres

0 0.1 0.2 0.3 0.4 0.5 km

0 0.09 0.18 0.27 0.36 0.45 mi

UTM 16 627069E 4570394N (NAD27)

Crane Lake, USGS Merriam (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

26.2 acres

MN G

M=-4.816
G=1.001

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 2

State of Indiana Department of Natural Resources

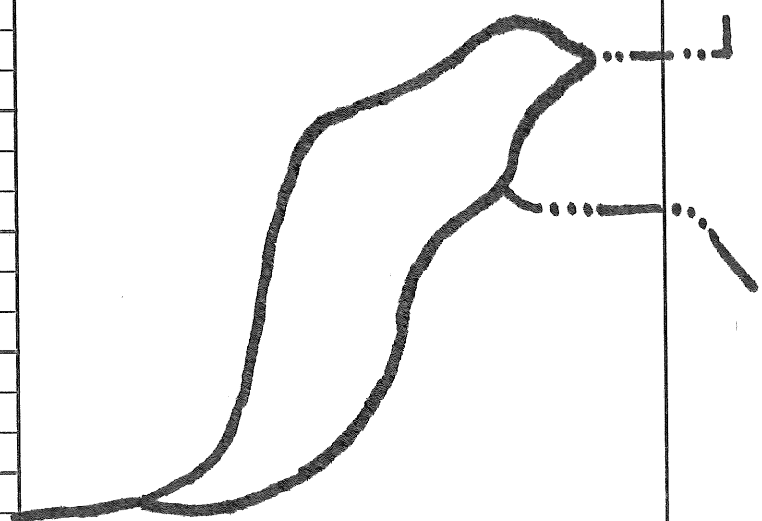
ORGANIZATION: Williams Creek	DATE:

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 01	Waterbody Name: Crane Lake	Center of the Bed
Bed Size: 45x4100		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 12	Max. Lakeward Extent of Bed
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 16' 26.51" N
	S: 3 N: 2 F: 2 E: 3	Longitude: 85° 29' 03.18" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
DECVER	3			
LEM13	3			
CEDE4	3			
~~ALGA~~	2			
NULU	3			
POCR3	3			
MYSP2	2			
WOCO	2			
SCI ACU	2			
PONCOR	1			
PHAARU	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 2

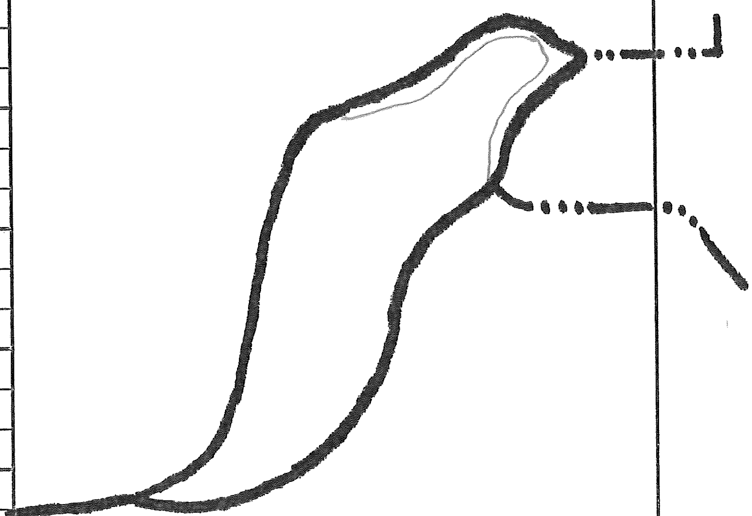
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/09/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 02	Waterbody Name: Crane Lake	Center of the Bed	
Bed Size: 75 X 1500		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 11	Max. Lakeward Extent of Bed	
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 16' 46.93" N	
	S: 3 N: 2 F: 2 E: 3	Longitude: 85° 28' 51.97" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CEDE4	3	0	0	
LEMI3	2			
MYSP2	3			
NULU	3			
ALLIA	2			
WOCO	2			
TYPSPP	2			
NYTU	3			
DECVER	4			
POPE6	2			
PHA ARU	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: Crooked Lake

Lake ID: —

County: Whitley/Noble

Date: 08/02

Habitat Stratum: 1L

Ave. Lake Depth (ft): 43

Lake Level: 906

GPS Metadata

Datum: NAD 83

Zone: 16

Accuracy: PDOP

Crew Leader: B. Neilson

Recorder: B. Neilson

Method: D

Secchi Depth (ft): 21'

Total # of Plant Beds Surveyed: 14

Total # of Species: 22

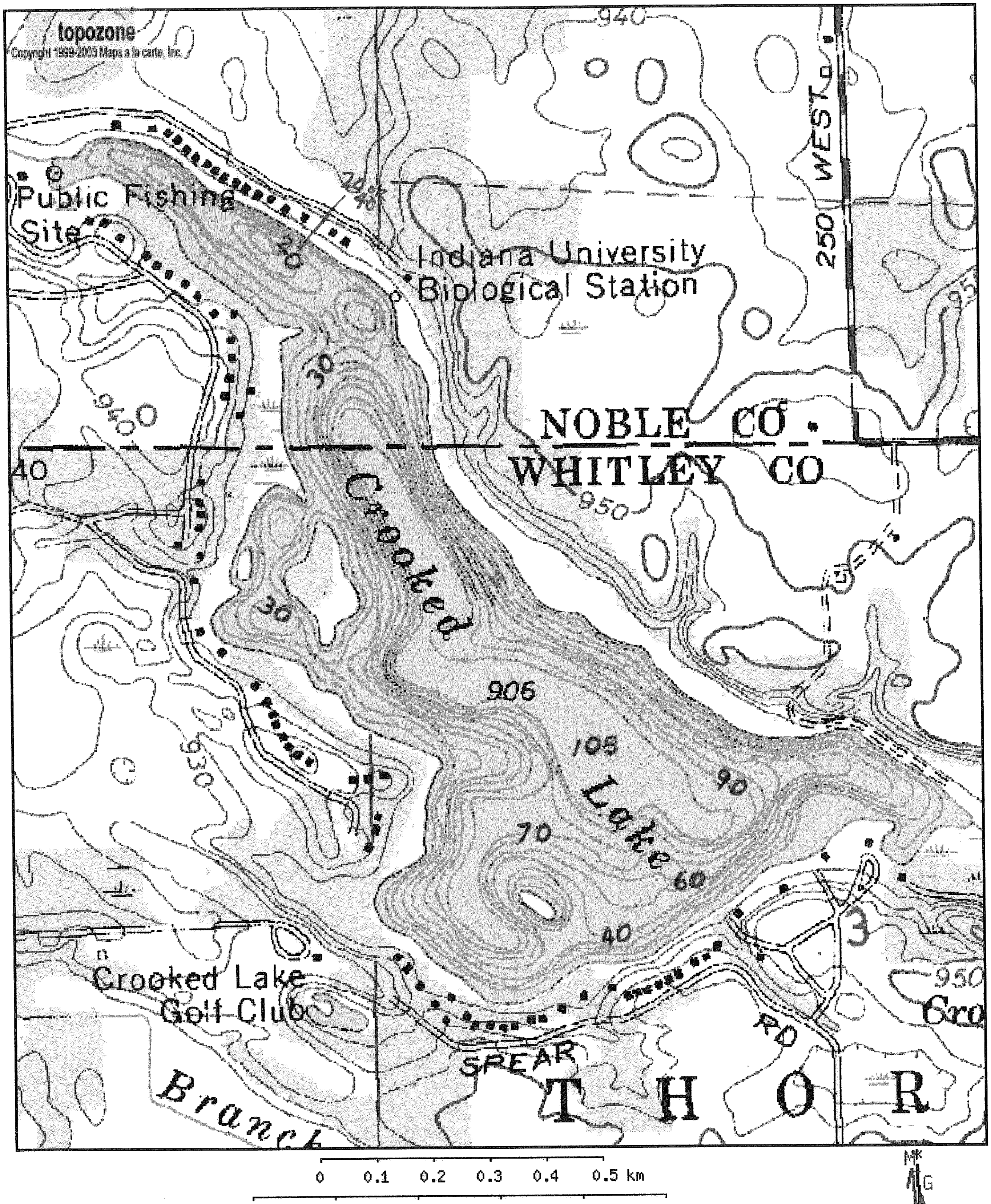
Littoral Zone Size (acres): 45.1

- ☐ Measured
- ☑ Estimated

Littoral Zone Max. Depth (ft): 63'

- ☐ Measured
- ☑ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:



UTM 16 627376E 4568882N (NAD27)

Crooked Lake, USGS Merriam (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

164 acres - Big Crooked

10.6 acres - Little Crooked

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of ___

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek

DATE: 08/02/2007

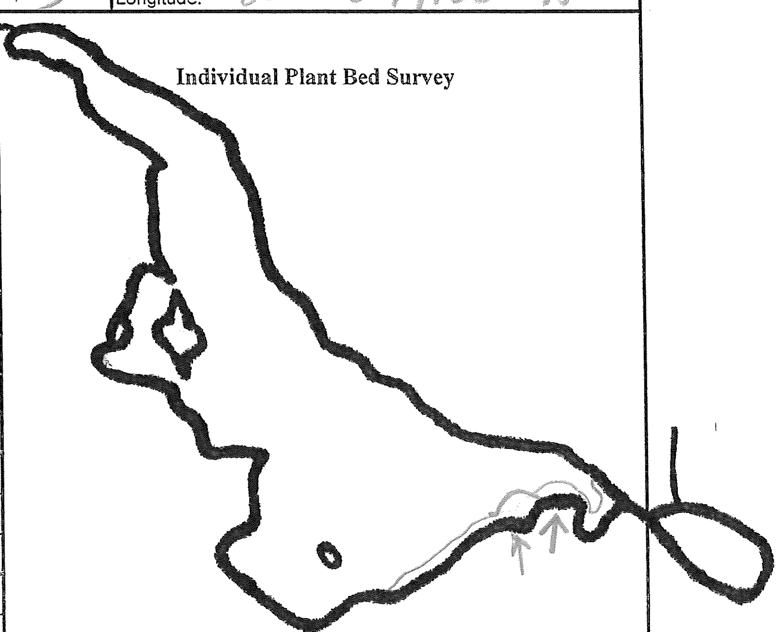
SITE INFORMATION						SITE COORDINATES
Plant Bed ID: 01	Waterbody Name: Crooked Lake					Center of the Bed
Bed Size: 95 X 2900						Latitude:
Substrate: 2	Waterbody ID:					Longitude:
Marl? 0	Total # of Species 16					Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site					Latitude: 41° 15' 33.24" N
	S: 3	N: 1	F: 3	E: 3		Longitude: 85° 28' 14.65" W

SPECIES INFORMATION

TO BIG

Species Code	Abundance	QE	Vchr.	Ref. ID
VAAM3	2	9	9	
SCIAME	1			
POPE6	2			
CH?AR	3			
POIL	2			
POEP2	2			
TYPSPP	2			
MYSP2	2			
CEDE4	2			
ALGA	1			
NYTU	2			
NULU	2			
DEC VER	3			
HIB MOS	3			
SAC4	2			
CEP OCC	1			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of ___

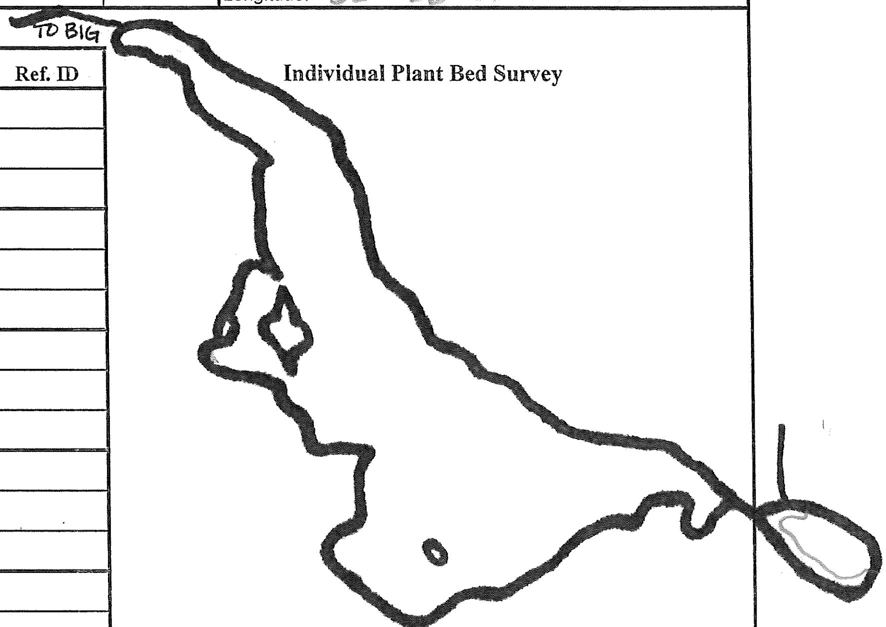
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 02	Waterbody Name: Crooked Lake	Center of the Bed	
Bed Size: 60 X 2150		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 12	Max. Lakeward Extent of Bed	
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 15' 26.42" N	
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 28' 01.30" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPE6	2	0	0	
CEDE4	2			
NYTU	3			
NULU	3			
ALGA	1			
DECVER	3			
SACU	2			
MYSP2	2			
POLHYD	2			
TYPSPP	2			
HIBMOS	2			
PONCOR	2			

Individual Plant Bed Survey



Comments:

LITTLE CROOKED

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of ___

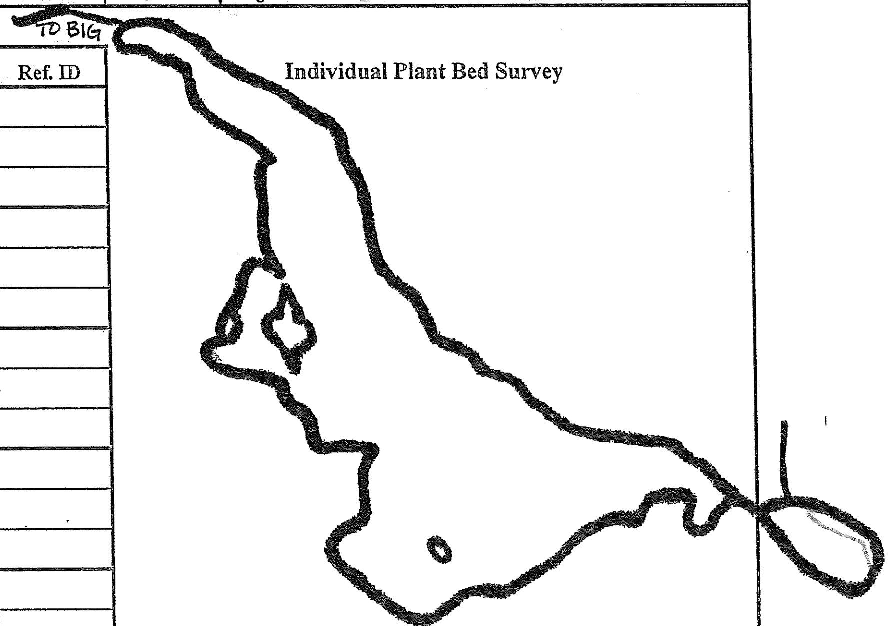
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek				DATE: 08/02/2007
SITE INFORMATION				**SITE COORDINATES**
Plant Bed ID: 03	Waterbody Name: Crooked Lake			Center of the Bed
Bed Size: 60 X 860				Latitude:
Substrate: 2	Waterbody ID:			Longitude:
Marl? 0	Total # of Species 8			Max. Lakeward Extent of Bed
High Organic? 1	Canopy Abundance at Site			Latitude: 41° 15' 29.78" N
	S: 3	N: 1	F: 2 E: 3	Longitude: 85° 27' 56.43" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
SACU	3	0	0	
ALGA	2			
NYTU	3			
NULU	3			
MYSP2	3			
CEDE4	2			
TYPSPP	2			
DECVER	4			

Individual Plant Bed Survey



Comments:

LITTLE CROOKED

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of ___

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek

DATE: 08/02/2007

SITE INFORMATION

Plant Bed ID: 04	Waterbody Name: Crooked Lake				
Bed Size: 80 X 1100					
Substrate: 2	Waterbody ID:				
Marl? 0	Total # of Species 3				
High Organic? 0	Canopy Abundance at Site				
	S: 3	N:	F:	E: 4	

SITE COORDINATES

Center of the Bed

Latitude:

Longitude:

Max. Lakeward Extent of Bed

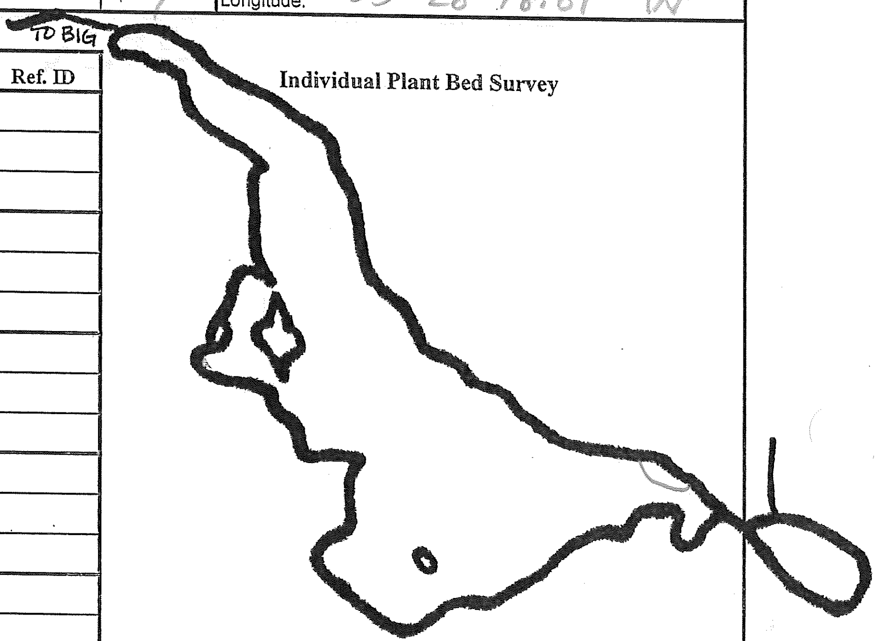
Latitude: 41° 15' 37.17" N

Longitude: 85° 28' 18.81" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
SCI ACU	3	0	0	
POIL	2	↓	↓	
SCI AME	3	↓	↓	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of ___

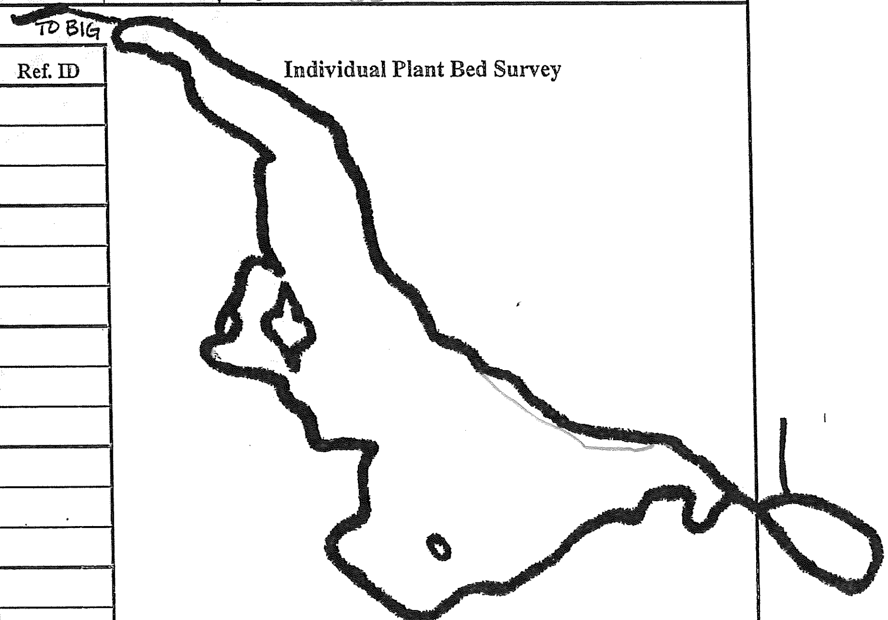
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 05	Waterbody Name: Crooked Lake	Center of the Bed	
Bed Size: 77X900		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 13	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 15' 41.30" N	
	S: 3 N: 1 F: 3 E: 2	Longitude: 85° 28' 32.13" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3	0	0	
VAAM3	2			
POPE6	3			
SCI AME	3			
MYSP2	3			
CEDE4	2			
POIL	3			
PONO2	2			
ALGA	1			
PON COR	3			
CHARA	3			
SACU	1			
POCR3	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of ___

State of Indiana Department of Natural Resources

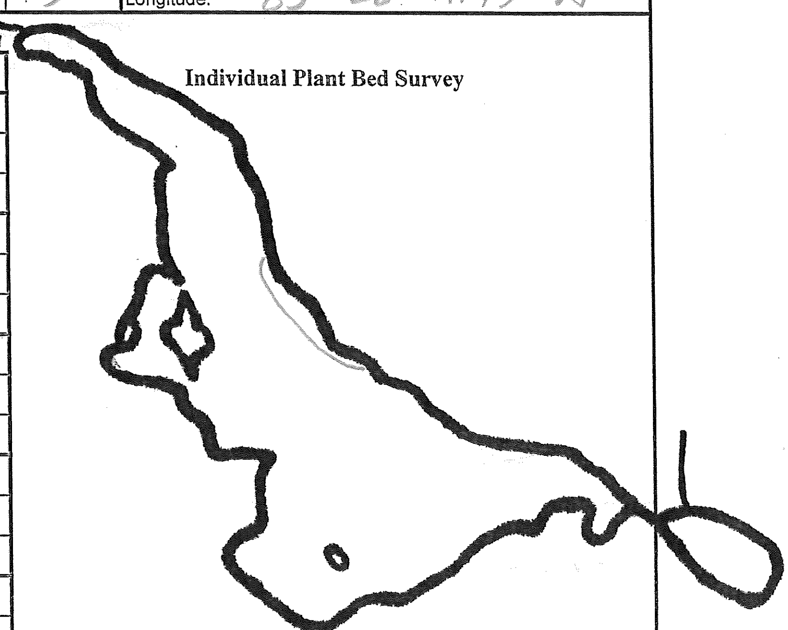
ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 06	Waterbody Name: Crooked Lake	Center of the Bed	
Bed Size: 150 X 1500		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 12	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 15' 47.43" N	
	S: 4 N: 1 F: 3 E: 3	Longitude: 85° 28' 41.43" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
NULU	3			
CHARA	3			
SCI AME	2			
MYSP2	3			
POIL	3			
POPE6	3			
DEC VER	3			
HIB MOS	3			
ALGA	1			
SCI ACU	2			
PON COR	2			

TO BIG

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of ___

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	

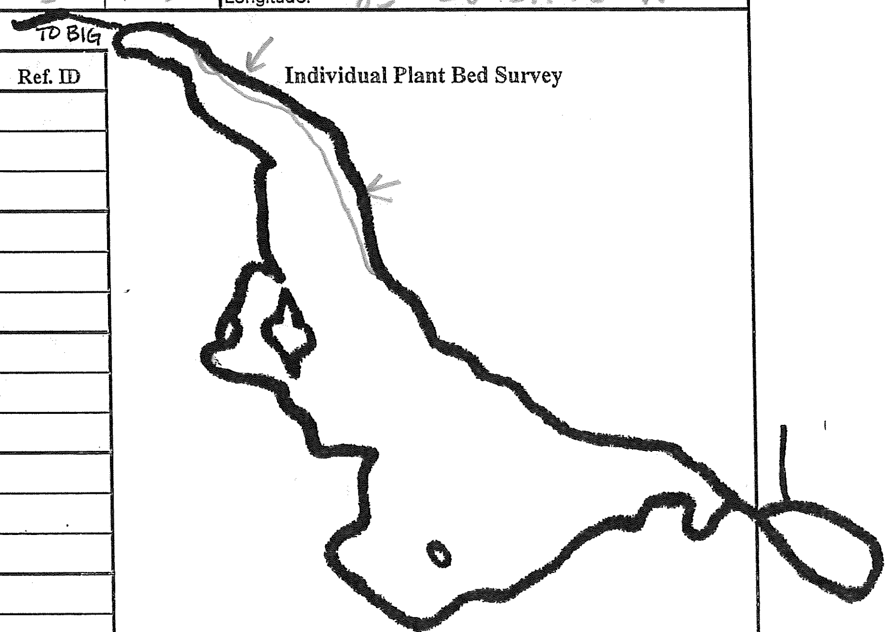
SITE INFORMATION		SITE COORDINATES	
Plant Bed ID: 07	Waterbody Name: Crooked Lake	Center of the Bed	
Bed Size: 95X 2900		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 14	Max. Lakeward Extent of Bed	
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 15' 57.86" N	
	S: 3 N: 2 F: 3 E: 3	Longitude: 85° 28' 51.78" W	

SPECIES INFORMATION

TO BIG

Species Code	Abundance	QE	Vchr.	Ref. ID
POPE6	2	0	0	
POIL	2			
NYTU	3			
SCIAME	2			
CH?RA	3			
MYSP2	3			
ALGA	2			
NULU	3			
DECVER	3			
TYPSPP	3			
PONCOR	2			
SAC4	3			
LYTSAL	1			
VAAM3	2			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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Reference ID:
Unique number or
letter to denote specific
location of a species;
referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 8 of ___

State of Indiana Department of Natural Resources

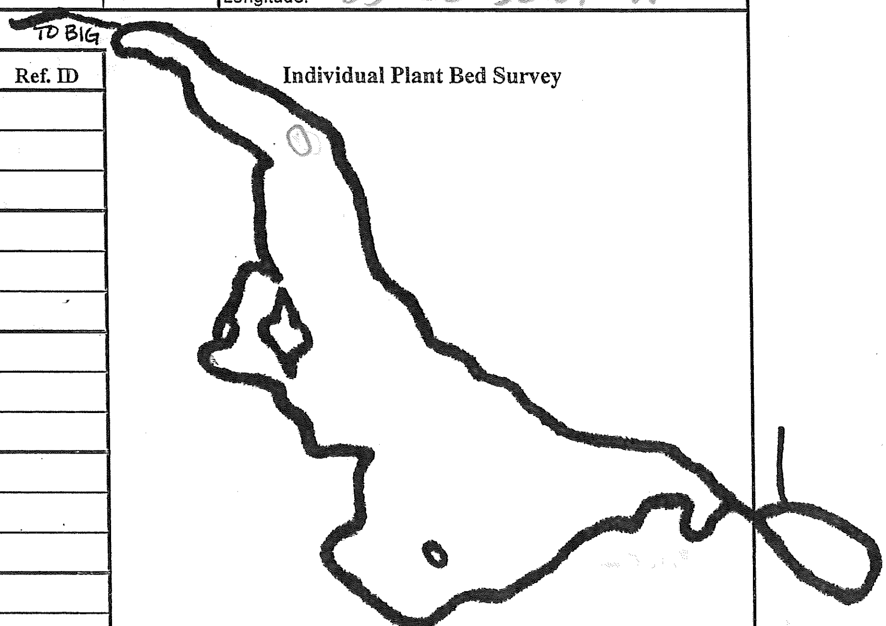
ORGANIZATION: Williams Creek		DATE:	08/02/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 08	Waterbody Name: Crooked Lake				Center of the Bed
Bed Size: 145 x 200					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 5				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: 41° 16' 02.82" N
	S: 4	N:	F: 2	E:	Longitude: 85° 28' 56.07" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3	0	0	
ALGA	2	0	0	
NYTU	2	0	0	
NULU	2	0	0	
CH?RA	3	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 9 of ___

State of Indiana Department of Natural Resources

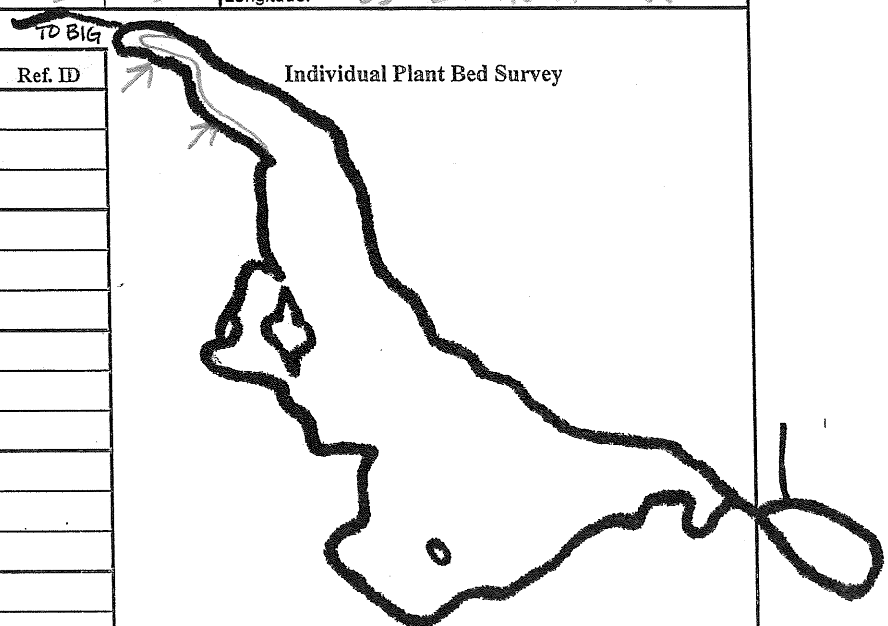
ORGANIZATION: Williams Creek	DATE: 08/02/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 09	Waterbody Name: Crooked Lake				Center of the Bed
Bed Size: 65 X 2550					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 16				Max. Lakeward Extent of Bed
High Organic? 1	Canopy Abundance at Site				Latitude: 41° 16' 12.77" N
	S: 3	N: 2	F: 3	E: 3	Longitude: 85° 29' 16.17" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
MYSP2	3	|	|	
NULU	3	|	|	
TYPSPP	2	|	|	
HIB MOS	1	|	|	
SACH	2	|	|	
ALGA	2	|	|	
DECVER	2	|	|	
POIL	3	|	|	
CEDE4	2	|	|	
POPE6	2	|	|	
LYT SAL	1	|	|	
POL HYD	3	|	|	
PON COR	3	|	|	
VAAM3	2	|	|	
CH?AR	2	↓	↓	

Individual Plant Bed Survey



Comments:
→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 10 of ___

State of Indiana Department of Natural Resources

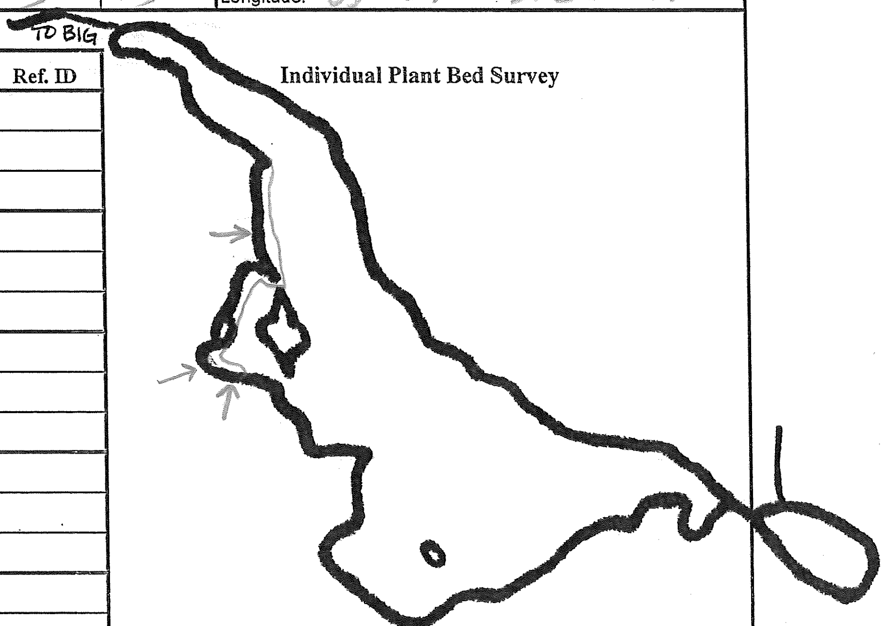
ORGANIZATION: Williams Creek		DATE: 08/02/2007	

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 10	Waterbody Name: Crooked Lake				Center of the Bed
Bed Size: 70 X 2520					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 13				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: 41° 15' 49.76" N
	S: 3	N: 1	F: 3	E: 3	Longitude: 85° 29' 03.22" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
POPE6	3			
SACU	3			
MYSP2	3			
CH?RA	3			
TYP SPP	3			
ALGA	1			
NULU	3			
DEC VER	3			
LYT SAL	1			
POIL	3			
HIB MOS	2			
CEDE4	2			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 11 of ___

State of Indiana Department of Natural Resources

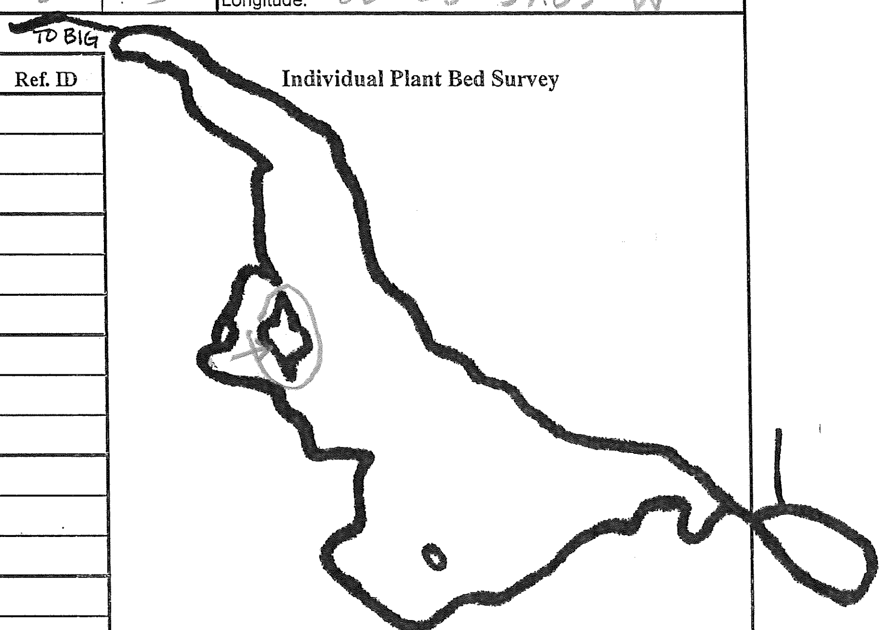
ORGANIZATION: Williams Creek			DATE: 08/02/2007

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 11	Waterbody Name: Crooked Lake	Center of the Bed
Bed Size: 100 X 1200		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 11	Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 15' 48.02" N
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 28' 57.03" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
SACU	2			
NYTU	3			
NULU	3			
ALGA	1			
POPE6	2			
LYT SAL	1			
DEC VER	3			
HIB MOS	2			
CH2RA	3			
MYSP2	2			
POIL	2			

Individual Plant Bed Survey



Comments:
→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 12 of ___

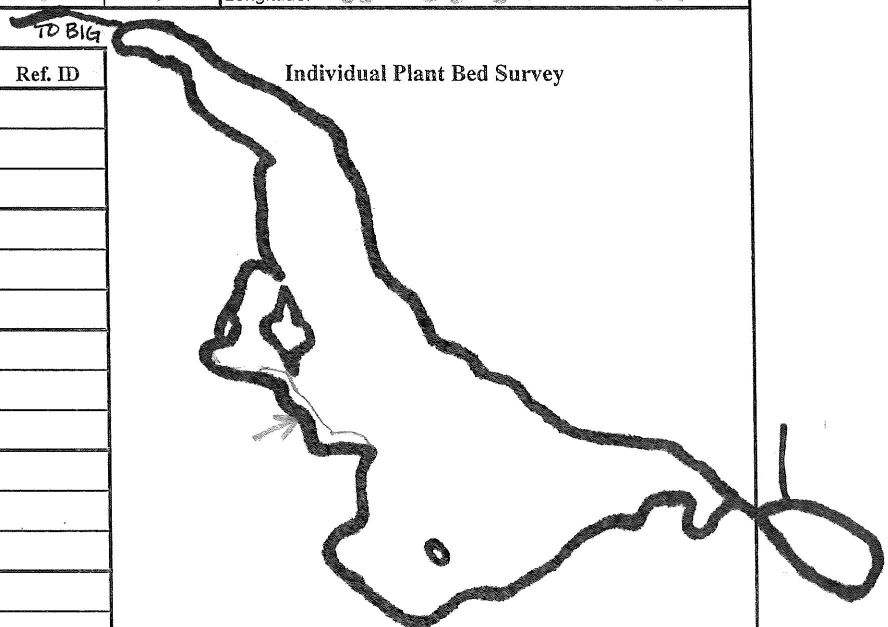
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 12	Waterbody Name: Crooked Lake	Center of the Bed	
Bed Size: 90 X 1300		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 1	Total # of Species 13	Max. Lakeward Extent of Bed	
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 15' 42.29" N	
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 28' 59.26" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3			
POPE6	3			
MYSP2	3			
SACU	3			
LYT SAL	1			
TYP SPP	2			
DEC VER	3			
CH ? RA	3			
ALGA	2			
POIL	3			
PON COR	2			
SCI ACU	2			
HIB MOS	2			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 13 of ___

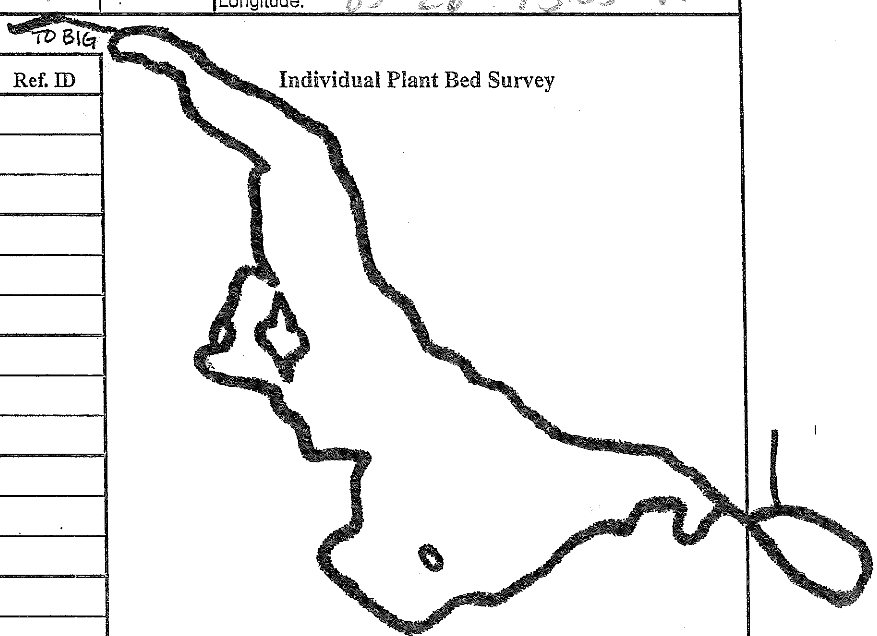
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek					DATE:	08/02/2007
SITE INFORMATION					SITE COORDINATES	
Plant Bed ID: 13	Waterbody Name: Crooked Lake				Center of the Bed	
Bed Size: 110X200					Latitude:	
Substrate: 2	Waterbody ID:				Longitude:	
Marl? 0	Total # of Species 5				Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site				Latitude:	41° 15' 28.47" N
	S: 4	N:	F: 1	E:	Longitude:	85 28' 45.05" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3			
POPE6	3			
CH?AR	3			
POIL	3			
CEDE4	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 14 of ___

State of Indiana Department of Natural Resources

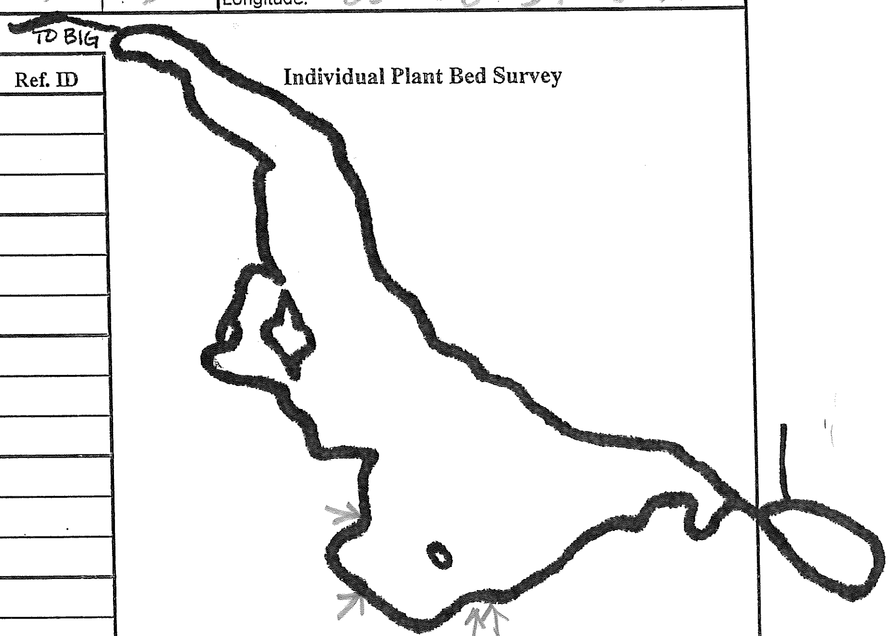
ORGANIZATION: Williams Creek	DATE: 08/02/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 14	Waterbody Name: Crooked Lake				Center of the Bed
Bed Size: 70 X 2950					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 17				Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site				Latitude: 41° 15' 29.73" N
	S: 3	N: 1	F: 3	E: 3	Longitude: 85° 28' 54.38 W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPE6	3			
POIL	3			
CHARA	3			
SACU	3			
MYSP2	3			
DEC VER	3			
NYTU	3			
NULU	3			
LYT SAL	2			
ALGA	1			
SCI ACU	2			
TYP SPP	3			
HIB MOS	2			
POCR3	2			
SCI AME	2			
PONO2	2			
POL HYD	2			

Individual Plant Bed Survey



Comments:
→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: Goose Lake

Lake ID: —

County: WHITLEY

Date: 08/02/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 26

Lake Level: 911

GPS Metadata

Datum: NAD83

Zone: 16

Accuracy: PDOP

Crew Leader: B. NEILSON

Recorder: B. NEILSON

Method: D.

Secchi Depth (ft): 4.0'

Total # of Plant Beds Surveyed: 4

Total # of Species: 13

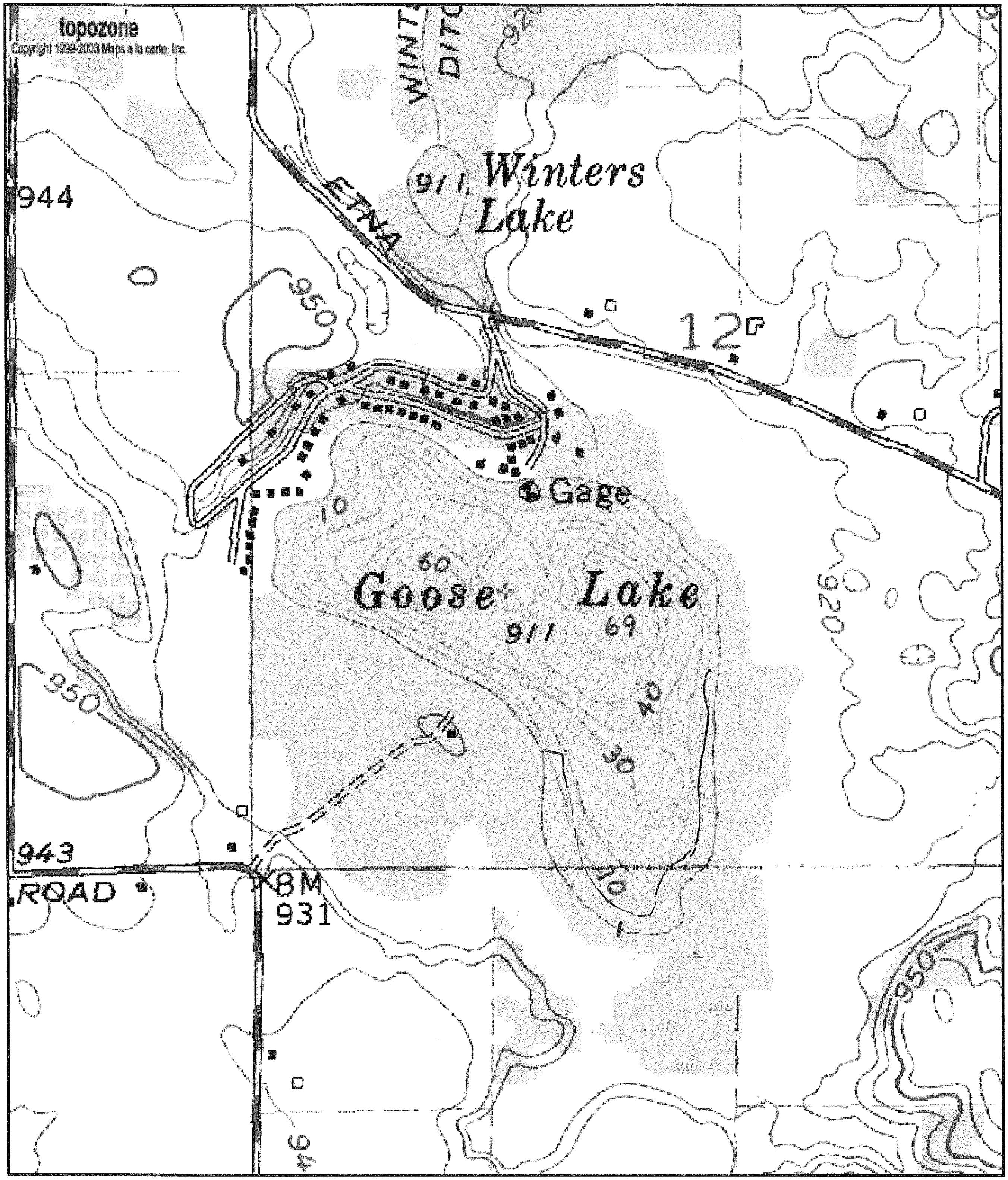
Littoral Zone Size (acres): 10.1

- ☐ Measured
- ☑ Estimated

Littoral Zone Max. Depth (ft): 12 FT

- ☐ Measured
- ☑ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:



0 0.1 0.2 0.3 0.4 0.5 km

0 0.09 0.18 0.27 0.36 0.45 mi

UTM 16 621274E 4566138N (NAD27)

Goose Lake, USGS Lorane (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

M=-4.747
G=0.954

80.8acres

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 4

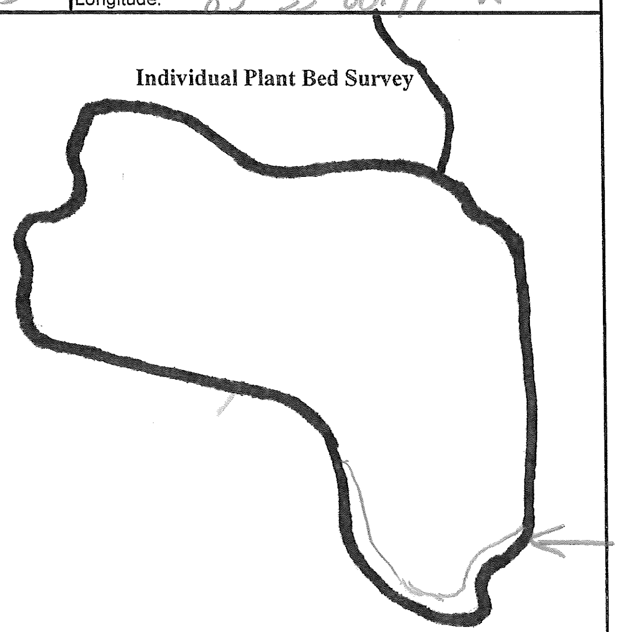
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 01	Waterbody Name: Goose Lake	Center of the Bed	
Bed Size: 45 x 200		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 9	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 14' 05.67" N	
	S: 3 N: 1 F: 2 E: 3	Longitude: 85° 33' 00.77" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	9	0	
NULU	3			
ALMA	2			
SACU	2			
MYSP2	1			
POPE6	1			
DECVER	2			
LYT SAL	1			
CEDE4	2			

Individual Plant Bed Survey



Comments:
→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

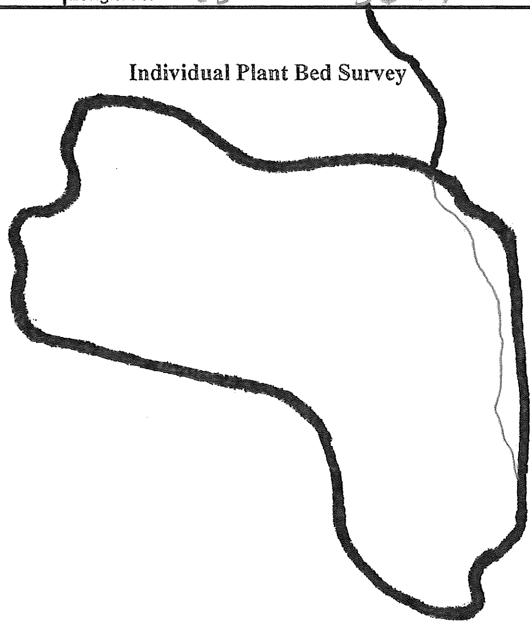
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/02/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 02	Waterbody Name: Goose Lake	Center of the Bed	
Bed Size: 75 X 2100		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 9	Max. Lakeward Extent of Bed	
High Organic? 1	Canopy Abundance at Site	Latitude: 41° 14' 21.91" N	
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 32' 56.24" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3	0	0	
NYTU	3			
CEDE 4	3			
MYSP2	3			
ALEIA	3			
PONCOR	3			
TYP SPP	2			
SACU	2			
DECVER	3			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 4

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek

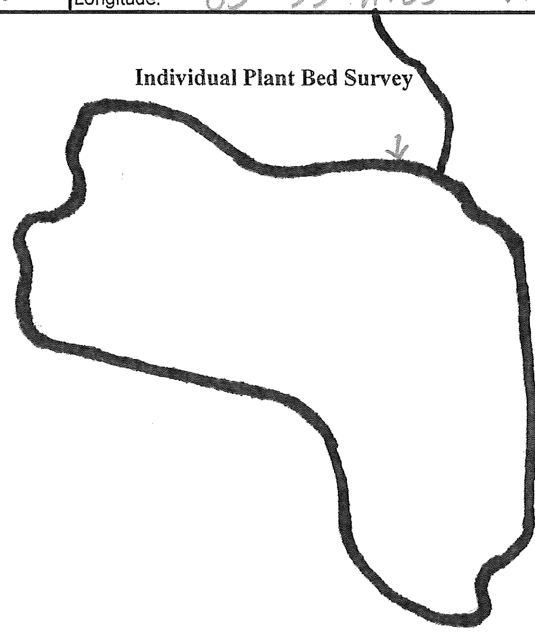
DATE: 08/02/2007

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 03	Waterbody Name: Goose Lake	Center of the Bed
Bed Size: 35 X 1300		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 11	Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 14' 27.73" N
	S: 3 N: 1 F: 2 E: 2	Longitude: 85° 33' 11.05 W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CEPE 4	3	0	0	
MYSP 2	3			
VAAM 3	2			
LYT SAL	1			
CH ? AR	2			
ALGA	1			
SACU	2			
TYP SPP	2			
POPE6	3			
NYTU	3			
NULU	2			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 4

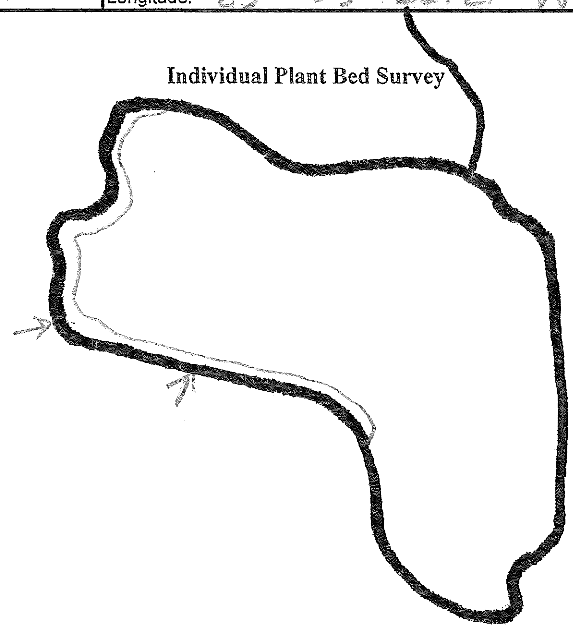
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek				DATE:
SITE INFORMATION				**SITE COORDINATES**
Plant Bed ID: 04	Waterbody Name: Goose Lake			Center of the Bed
Bed Size:				Latitude:
Substrate: 2	Waterbody ID:			Longitude:
Marl? 0	Total # of Species 11			Max. Lakeward Extent of Bed
High Organic? 1	Canopy Abundance at Site			Latitude: 41° 14' 24.92" N
	S: 3	N: 1	F: 3 / E: 3	Longitude: 85° 33' 26.21" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
SACU	3	0	0	
NYTU	3			
ALGA	3			
NULU	2			
DECVER	3			
LYTSAL	2			
MYSP2	3			
CEDE4	3			
VAAM3	2			
PONCOR	3			
TYPSPP	3			

Individual Plant Bed Survey



Comments:
→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: Loon Lake

Lake ID: —

County: NOBLE/WHITLEY

Date: 08/01/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 26'

Lake Level: 895'

GPS Metadata

Datum: NAD 83

Zone: 16

Accuracy: PDOP

Crew Leader: B. NEILSON

Recorder: B. NEILSON

Method: D

Secchi Depth (ft): 4'

Total # of Plant Beds Surveyed: 6

Total # of Species: 13

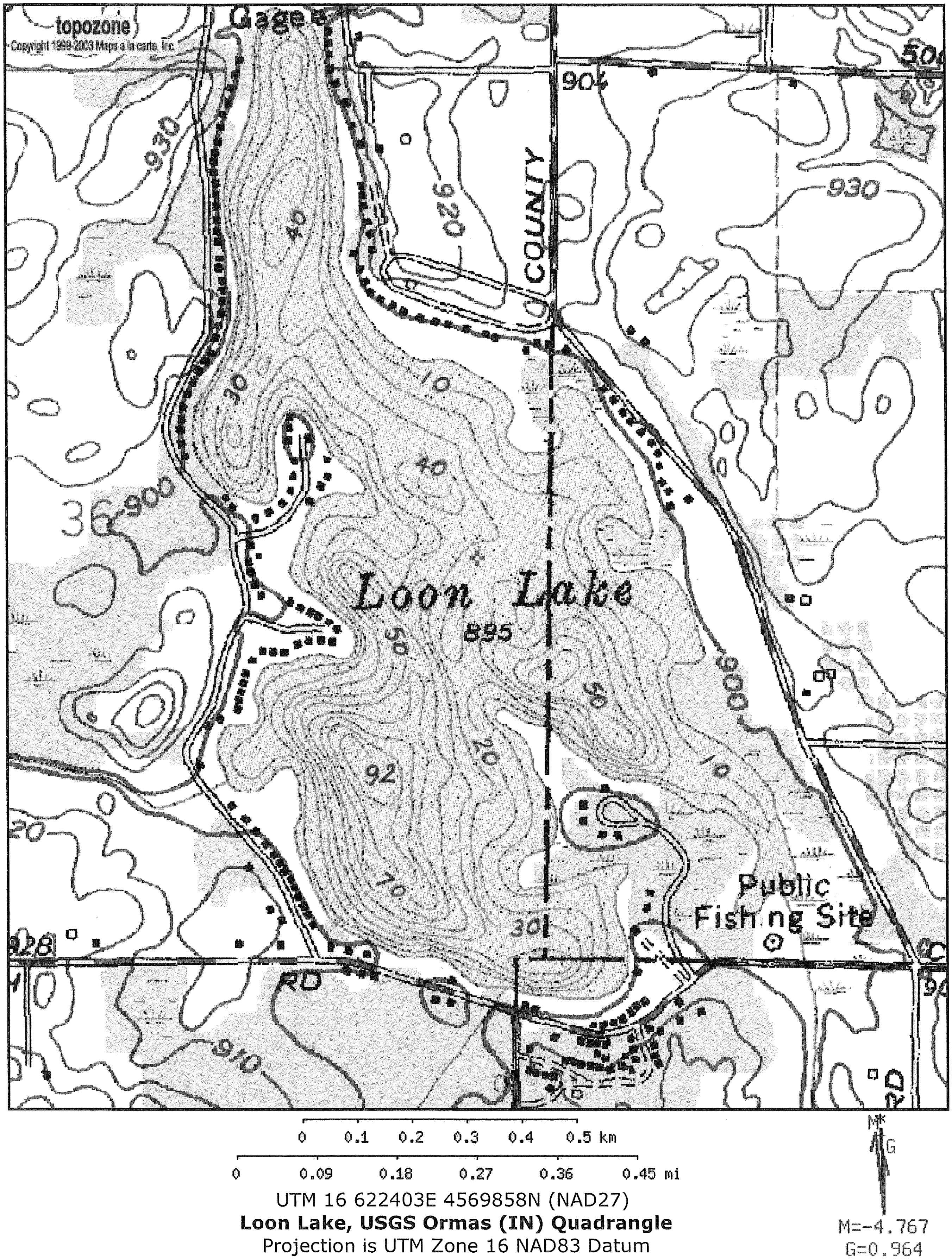
Littoral Zone Size (acres): 41.7

- ☐ Measured
- ☑ Estimated

Littoral Zone Max. Depth (ft): 12'

- ☐ Measured
- ☑ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions: PURPLE LOOSESTRIFE IN PLANT BEDS 1 & 3



UTM 16 622403E 4569858N (NAD27)

Loon Lake, USGS Ormas (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

197 acres

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 6

State of Indiana Department of Natural Resources

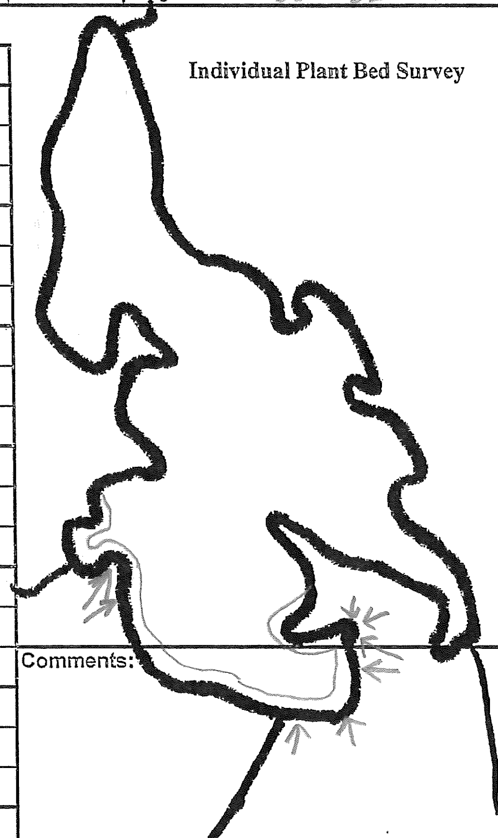
ORGANIZATION: Williams Creek	DATE: 08/01/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 01	Waterbody Name: Loon Lake				Center of the Bed
Bed Size: 75 X 6100					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 12				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: 41° 15' 57.41" N
	S: 3	N: 1	F: 3	E: 3	Longitude: 85° 32' 17.96" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3			
CEDE4	3			
MYSP2	3			
VAAM3	3			
ALGA	2			
NULU	3			
LYTSAL	2			
SCIAME	2			
POCR3	2			
SACU	2			
TYPSPP	2			
DECVER	2			

Individual Plant Bed Survey



Comments:

→ PURPLE LOOSESTRIFE

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 6

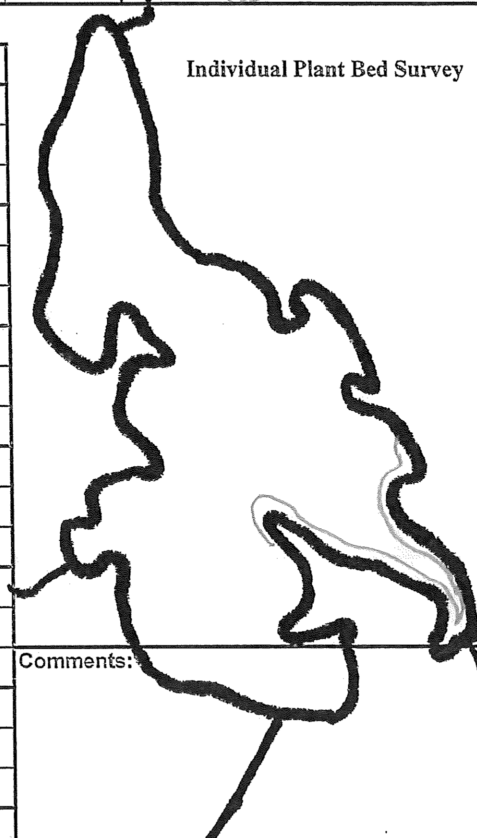
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		SITE COORDINATES	
Plant Bed ID: 02	Waterbody Name: Loon Lake	Center of the Bed	
Bed Size: 90 X 4670		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 8	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 16' 05.74" N	
	S: 3 N: 2 F: 3 E: 3	Longitude: 85° 31' 56.66" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
VAAM3	3			
NYTU	2			
CHZAR	2			
ALGA	2			
NULU	3			
DIEC VER	3			
CEDE4	3			
MYSP2	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 6

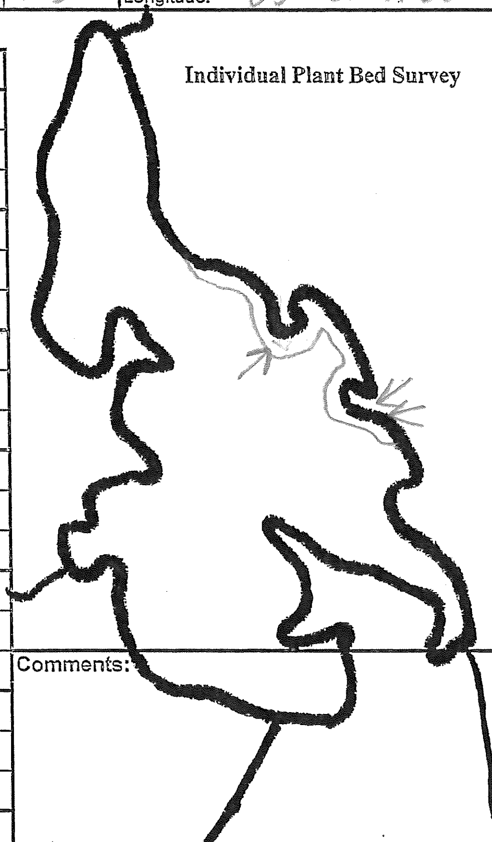
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2007	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 03	Waterbody Name: Loon Lake	Center of the Bed	
Bed Size: 95 X 4000		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 7	Max. Lakeward Extent of Bed	
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 16' 32.40" N	
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 32' 11.53" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CEDE 4	3			
MYSP 2	1			
ALGA	1			
NYTU	3			
NULU	3			
CH 3 AR	2			
VAAM 3	3			
LYTSAL	2			

Individual Plant Bed Survey



Comments:

→ PURPLELOOSESTRIFE

MEASUREMENT INCLUDES ISLANDS

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek

DATE: 08/01/2007

SITE INFORMATION

Plant Bed ID: 04
Bed Size: 65 X 1600
Substrate: 2
Marl? 0
High Organic? 0

Waterbody Name: Loon Lake
Waterbody ID:
Total # of Species 6

Canopy Abundance at Site

S: 3 N: / F: / E: 2

SITE COORDINATES

Center of the Bed

Latitude:
Longitude:

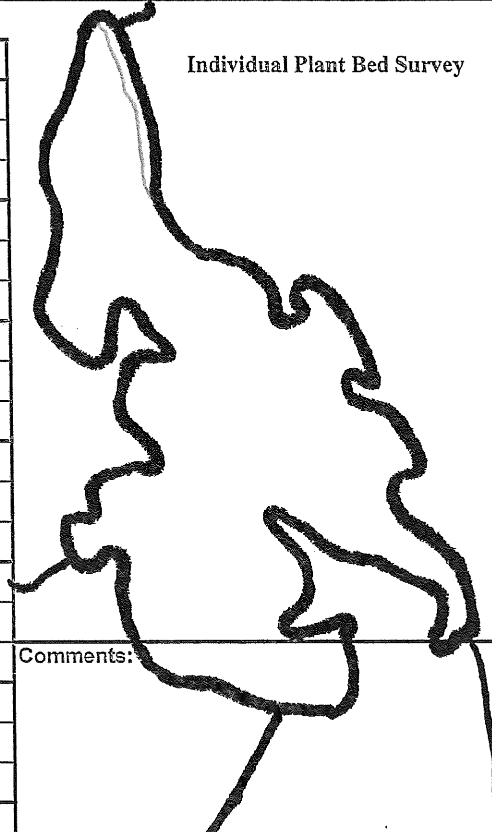
Max. Lakeward Extent of Bed

Latitude: 41° 16' 53.13" N
Longitude: 85° 32' 31.39" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3			
NULU	3			
TYPSPP	1			
VAAM3	3			
CH?AR	3			
ALMA	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 6

State of Indiana Department of Natural Resources

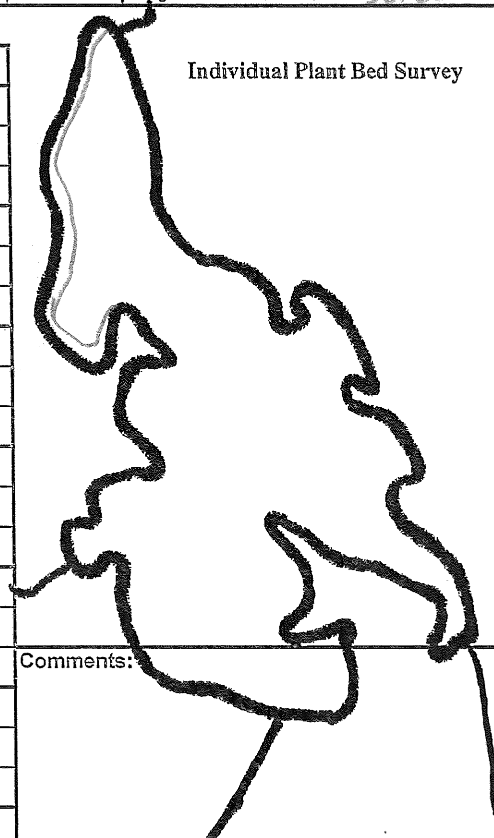
ORGANIZATION: Williams Creek		DATE: 08/01/2007	

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 05	Waterbody Name: Loon Lake	Center of the Bed
Bed Size: 70 X 4000		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 5	Max. Lakeward Extent of Bed
High Organic? 0	Canopy Abundance at Site	Latitude: 41° 16' 38.87" N
	S: / N: 2 / F: 3 / E: 3	Longitude: 85° 32' 36.56" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3			
ALGA	2			
NULU	3			
SCI AME	2			
TYP SPP	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek

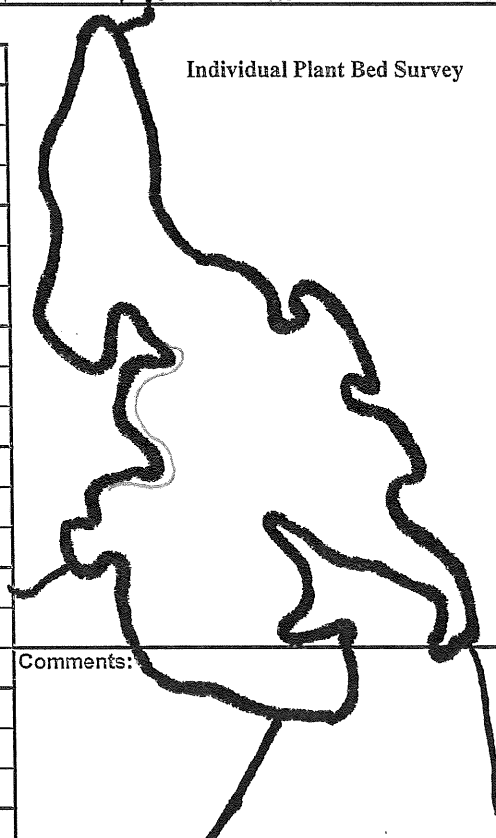
DATE: 08/01/2007

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 06	Waterbody Name: Loon Lake	Center of the Bed
Bed Size: 80X2000		Latitude:
Substrate: 7	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 6	Max. Lakeward Extent of Bed
High Organic? 6	Canopy Abundance at Site	Latitude: 41° 16' 21.72" N
	S: 3 N: 1 F: 3 E:	Longitude: 85° 32' 33.88" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3			
VAAM3	2			
ALGA	1			
CH?AR	2			
CEDE4	2			
MYSP2	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: New Lake

Lake ID: —

County: WHITLEY

Date: 08/01/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 22'

Lake Level: 904

GPS Metadata

Datum: NAD83

Zone: 16

Accuracy: PDOP

Crew Leader: B. NEILSON

Recorder: B. NEILSON

Method: D

Secchi Depth (ft): 5'

Total # of Plant Beds Surveyed: 3

Total # of Species: 14

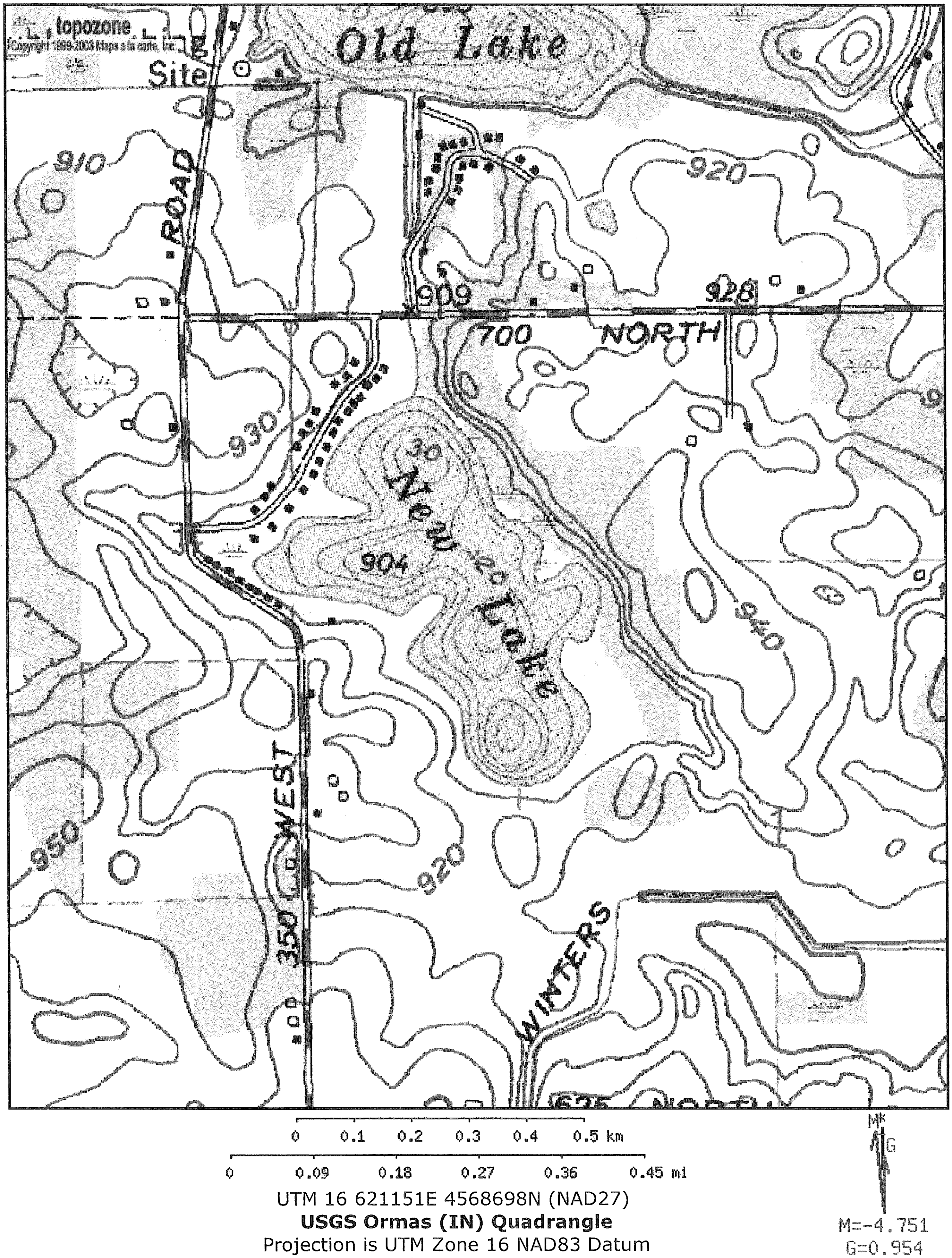
Littoral Zone Size (acres): 7.1

- [ ] Measured
- [x] Estimated

Littoral Zone Max. Depth (ft): 15'

- [ ] Measured
- [x] Estimate (historical Secchi)
- [ ] Estimated (current Secchi)

Notable Conditions:


topozone
Copyright 1999-2003 Maps a la carte, Inc.
Site
Old Lake
910
ROAD
920
909
928
700
NORTH
930
30
New Lake
904
20
940
950
WEST
920
350
WINTERS
625
0 0.1 0.2 0.3 0.4 0.5 km
0 0.09 0.18 0.27 0.36 0.45 mi
UTM 16 621151E 4568698N (NAD27)
USGS Ormas (IN) Quadrangle
Projection is UTM Zone 16 NAD83 Datum
MK
G
M=-4.751
G=0.954

47 acres

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 3

State of Indiana Department of Natural Resources

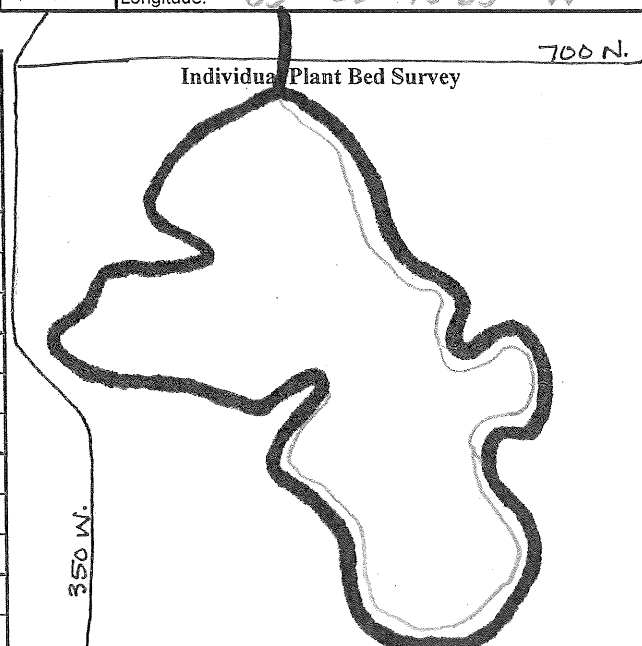
ORGANIZATION: Williams Creek	DATE: 08/01/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 01	Waterbody Name: New Lake				Center of the Bed
Bed Size: 45 x 4800					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 13				Max. Lakeward Extent of Bed
High Organic? 1	CanopyAbundance at Site				Latitude: 41° 15' 46.54" N
	S: 3	N: 1	F: 3	E: 2	Longitude: 85° 33' 10.85" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
SCIVAL	3			
POLHYD	3			
NULU	3			
ALGA	1			
PONCOR	1			
CH?AR	3			
TYP SPP	1			
MYSP2	2			
POTAMP	1			
DECVER	2			
SACU	2			
POPR12	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 3

State of Indiana Department of Natural Resources

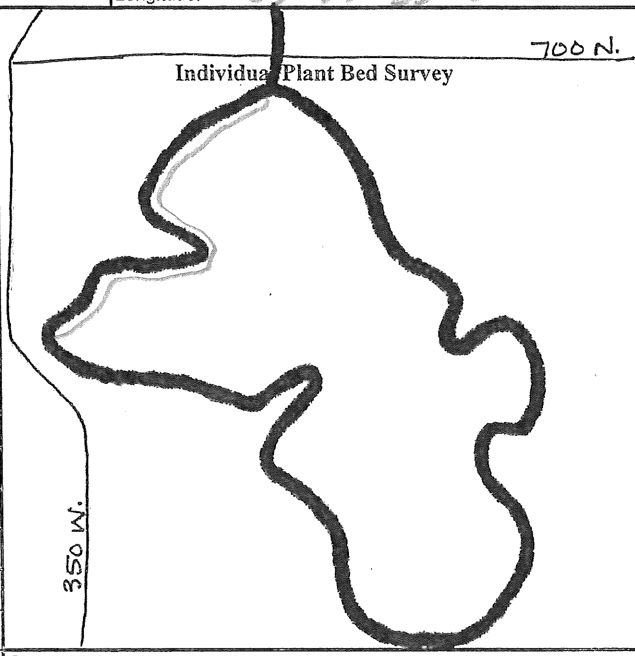
ORGANIZATION: Williams Creek	DATE: 08/01/2007

SITE INFORMATION		SITE COORDINATES
Plant Bed ID: 02	Waterbody Name: New Lake	Center of the Bed
Bed Size: 35 X 1800		Latitude:
Substrate: 2	Waterbody ID:	Longitude:
Marl? 0	Total # of Species 9	Max. Lakeward Extent of Bed
High Organic? 1	CanopyAbundance at Site	Latitude: 41° 15' 47.70" N
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 33' 25.76" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	4	0	0	
SCI VAL	3			
TYP SPP	2			
NULU	2			
POIL	3			
MYSP2	1			
DECVER	3			
CH?RA	2			
PON COR	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 3

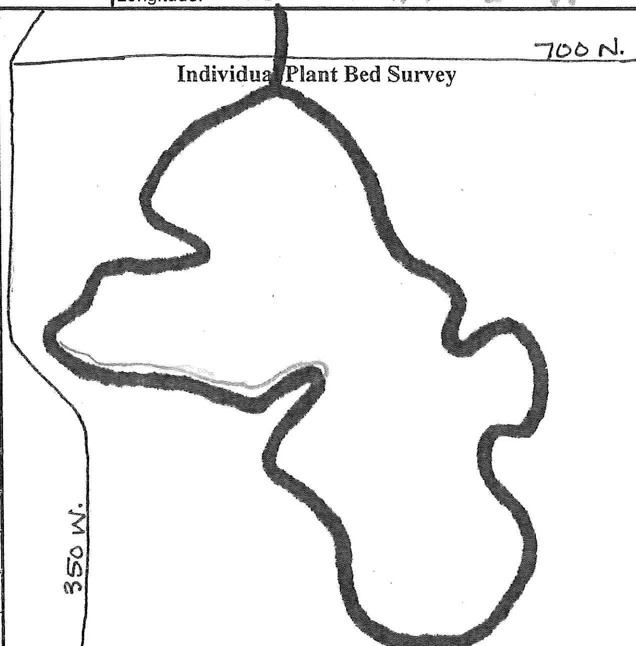
State of Indiana Department of Natural Resources

ORGANIZATION: Williams Creek		DATE: 08/01/2005	
SITE INFORMATION		**SITE COORDINATES**	
Plant Bed ID: 03	Waterbody Name: New Lake	Center of the Bed	
Bed Size: 35 X 1200		Latitude:	
Substrate: 2	Waterbody ID:	Longitude:	
Marl? 0	Total # of Species 8	Max. Lakeward Extent of Bed	
High Organic? 0	CanopyAbundance at Site	Latitude: 41° 15' 42.08" N	
	S: 3 N: 1 F: 3 E: 3	Longitude: 85° 33' 19.22" W	

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POIL	3	0	0	
POL HYD	3			
N YTU	3			
TYP SPP	2			
PON COR	2			
ALGA	2			
CH ? AR	2			
SCI VAL	3			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or
letter to denote specific
location of a species;
referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page ___ of ___

State of Indiana Department of Natural Resources

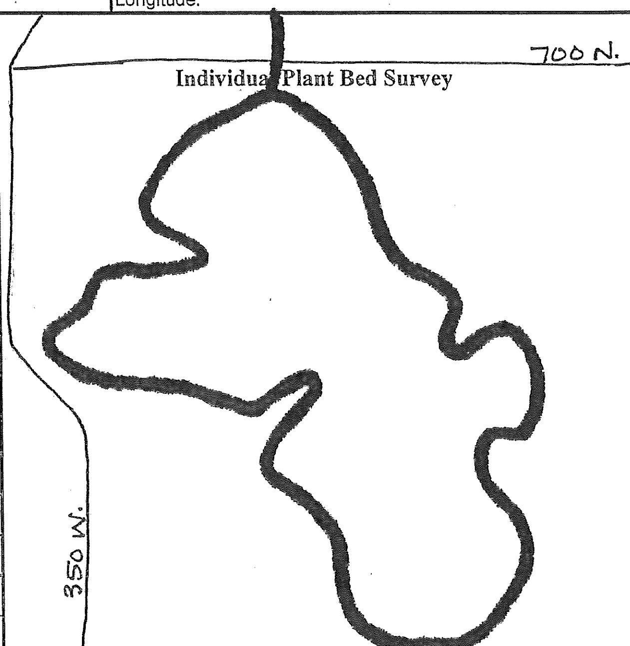
ORGANIZATION: Williams Creek	DATE:

SITE INFORMATION					SITE COORDINATES
Plant Bed ID:	Waterbody Name: New Lake				Center of the Bed
Bed Size:					Latitude:
Substrate:	Waterbody ID:				Longitude:
Marl?	Total # of Species				Max. Lakeward Extent of Bed
High Organic?	CanopyAbundance at Site				Latitude:
	S:	N:	F:	E:	Longitude:

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Williams Creek

Waterbody Name: Old Lake

Lake ID: —

County: WHITLEY

Date: 08/01/2007

Habitat Stratum: 1L

Ave. Lake Depth (ft): 19

Lake Level: 898

GPS Metadata

Datum: NAD83

Zone: 16

Accuracy: PDOP

Crew Leader: B. NEILSON

Recorder: B. NEILSON

Method: D

Secchi Depth (ft): 9.5

Total # of Plant Beds Surveyed: 3

Total # of Species: 12

Littoral Zone Size (acres): 6.1

- ☐ Measured
- ☑ Estimated

Littoral Zone Max. Depth (ft): 28.5'

- ☐ Measured
- ☑ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

UTM 16 621121E 4569615N (NAD27)

Old Lake, USGS Ormas (IN) Quadrangle

Projection is UTM Zone 16 NAD83 Datum

31.6 acres

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 3

State of Indiana Department of Natural Resources

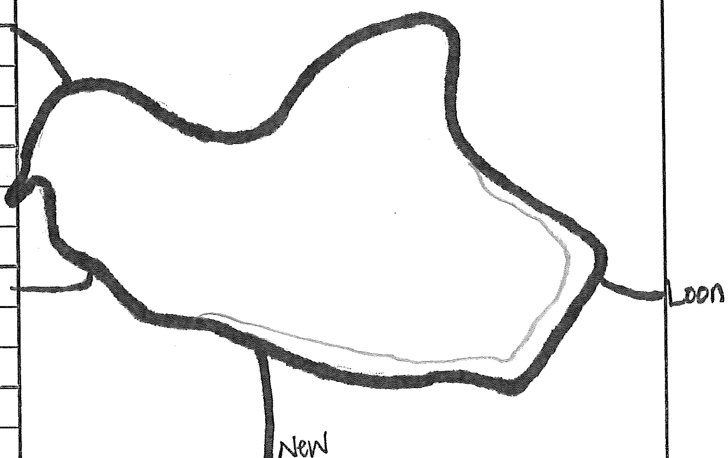
ORGANIZATION: Williams Creek	DATE:

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 01	Waterbody Name: Old Lake				Center of the Bed
Bed Size: 60 X 2250					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 9				Max. Lakeward Extent of Bed
High Organic? 1	CanopyAbundance at Site				Latitude: 41° 16' 13.52" N
	S: 3	N: 1	F: 3	E: 3	Longitude: 85° 33' 01.76" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CEDE 4	3			
NULU	3			
NYTU	3			
ALGA	1			
POCR3	2			
DEC VER	3			
TYPSPP	4			
MYSP2	2			
POPE6	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 3

State of Indiana Department of Natural Resources

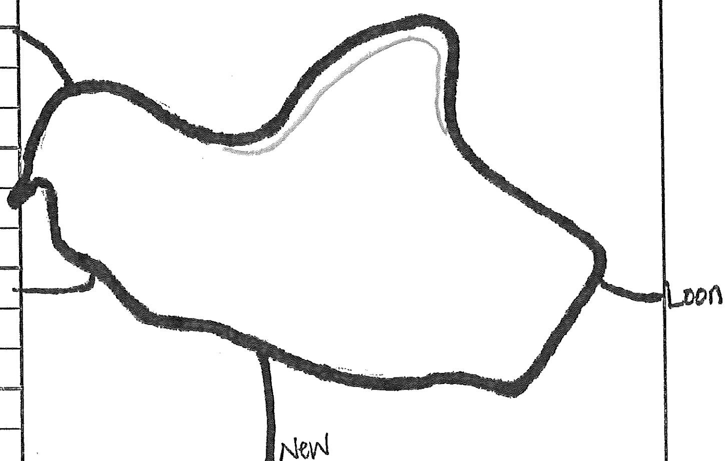
ORGANIZATION: Williams Creek	DATE: 08/01/2007

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 02	Waterbody Name: Old Lake				Center of the Bed
Bed Size: 50 x 1550					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 9				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: 41° 16' 19.59" N
	S: 3	N: 1	F: 3	E: 3	Longitude: 85° 33' 14.21" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3			
NYTU	3			
CEDE4	3			
DEC VER	3			
TYPSPP	3			
POPE6	2			
SACU	2			
PONCOR	2			
ALGA	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifiec

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 3

State of Indiana Department of Natural Resources

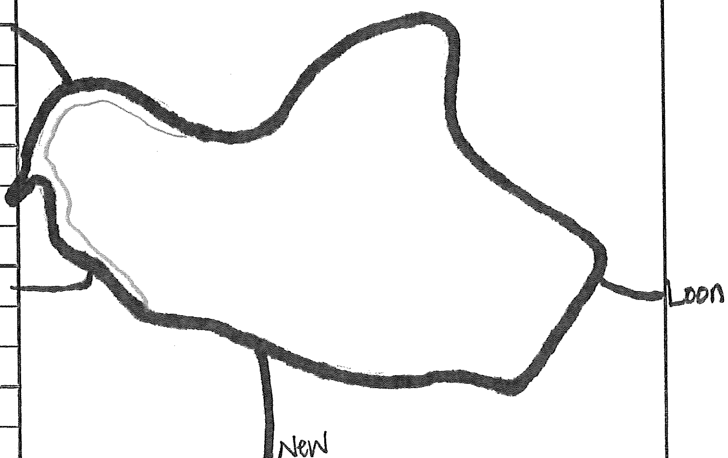
ORGANIZATION: Williams Creek	DATE:

SITE INFORMATION					SITE COORDINATES
Plant Bed ID: 03	Waterbody Name: Old Lake				Center of the Bed
Bed Size: 40 X 1300					Latitude:
Substrate: 2	Waterbody ID:				Longitude:
Marl? 0	Total # of Species 9				Max. Lakeward Extent of Bed
High Organic? 0	CanopyAbundance at Site				Latitude: 41° 16' 12.80" N
	S: 2	N: 1	F: 3	E: 3	Longitude: 85° 33' 24.30" W

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3			
CEDE4	3			
DECVER	3			
MYSP2	2			
POPE6	2			
PONCOR	2			
TYPSPP	3			
LEMI3	1			
ALGA	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Appendix F

UTRLA Seven Lakes STEPL Modeling Data

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom You entered 13 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Tabl

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table
(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tabl

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table
(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheet

Show optional input tables? Yes No

☑ Treat all the subwatersheds as parts of a single watershed ☐ Groundwater load calculation

State: Indiana

County: Whitley

Weather Station (for rain correction factors: IN FORT WAYNE WSO AP

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors		
									0.842	0.382	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	64	841	15	267	0	0	0-24%	1187	35.01	113.6	0.679
W2	12	166	18	40	0	0	0-24%	236	35.01	113.6	0.679
W3	147	150	136	101	0	1	0-24%	535	35.01	113.6	0.679
W4	24.9	129	28	57	0	1	0-24%	239.9	35.01	113.6	0.679
W5	114	1315	65	260	0	2	0-24%	1756	35.01	113.6	0.679
W6	120	1902	73	403	0	0	0-24%	2498	35.01	113.6	0.679
W7	86	208	14	84	0	0	0-24%	392	35.01	113.6	0.679
W8	140	917	2	148	0	1	0-24%	1208	35.01	113.6	0.679
W9	97	978	35	167	0	0	0-24%	1277	35.01	113.6	0.679
W10	163	59	29	253	0	0	0-24%	504	35.01	113.6	0.679
W11	21	147	1	43	0	0	0-24%	212	35.01	113.6	0.679
W12	56	527	3	104	0	0	0-24%	690	35.01	113.6	0.679
W13	31	995	2	46	0	0	0-24%	1074	35.01	113.6	0.679

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	0	0	0	15	0	0	0	0
W2	0	0	0	10	5	0	0	0	0
W3	14	0	0	0	10	0	0	0	0
W4	8	0	0	6	2	0	0	0	0
W5	10	46	8	0	0	0	0	0	0
W6	0	0	0	0	0	0	0	0	0
W7	29	100	0	8	0	0	0	0	0
W8	5	0	0	0	6	0	0	0	0
W9	0	0	0	0	0	0	0	0	0
W10	0	0	0	0	0	0	0	0	0
W11	0	0	0	0	0	0	0	0	0
W12	0	0	0	25	5	0	0	0	0
W13	4	0	5	15	9	0	0	0	0
Total	70	146	13	64	52	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	41	2.43	2	0	0
W2	10	2.43	2	0	0
W3	16	2.43	2	0	0
W4	6	2.43	2	0	0
W5	78	2.43	2	0	0
W6	76	2.43	2	0	0
W7	18	2.43	2	0	0
W8	49	2.43	2	0	0
W9	96	2.43	2	0	0
W10	19	2.43	2	0	0
W11	6	2.43	2	0	0
W12	17	2.43	2	0	0
W13	13	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest					User Defined				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W2	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W3	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W4	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W5	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W6	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W7	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W8	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W9	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W10	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W11	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W12	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000
W13	160.000	0.324	0.477	0.200	1.000	160.000	0.324	0.477	0.040	1.000	160.000	0.324	0.477	0.003	1.000	160.000	0.100	0.010	0.001	1.000

Best Management Practice Select an appropriate BMP except "Combined BMPs-Calculated" for each subwatershed in each land use table using the pull-down list-box if interactions between BMPs are not considered. Select "Combined BMPs-Calculated" if multiple BMPs and their interactions in the subwatersheds are considered; use BMP calculator (under STEPL menu) to obtain the combined BMP efficiencies and enter them in Table 7.

Urban BMP Tool

Gully and Streambank Erosion

1. BMPs and efficiencies for different pollutants on CROPLAND, ND=No Data

Watershed	Cropland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0.864	0.862	0	0.911	Combined BMPs-Calculated	100
W2	0.864	0.862	0	0.91	Combined BMPs-Calculated	100
W3	0.861	0.86	0	0.906	Combined BMPs-Calculated	100
W4	0.862	0.86	0	0.907	Combined BMPs-Calculated	100
W5	0.863	0.861	0	0.909	Combined BMPs-Calculated	100
W6	0.864	0.862	0	0.912	Combined BMPs-Calculated	100
W7	0.865	0.862	0	0.912	Combined BMPs-Calculated	100
W8	0.863	0.861	0	0.909	Combined BMPs-Calculated	100
W9	0.863	0.861	0	0.91	Combined BMPs-Calculated	100
W10	0.842	0.847	0	0.876	Combined BMPs-Calculated	100
W11	0.858	0.858	0	0.901	Combined BMPs-Calculated	100
W12	0.863	0.861	0	0.909	Combined BMPs-Calculated	100
W13	0.865	0.863	0	0.913	Combined BMPs-Calculated	100

2. BMPs and efficiencies for different pollutants on PASTURELAND, ND=No Data

Watershed	Pastureland					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W2	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W3	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W4	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W5	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W6	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W7	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W8	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W9	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W10	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W11	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W12	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100
W13	0.5325	0.6125	0	0.65	Combined BMPs-Calculated	100

3. BMPs and efficiencies for different pollutants on FOREST, ND=No Data

Watershed	Forest					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0	0	0	0	0 No BMP	100
W2	0	0	0	0	0 No BMP	100
W3	0	0	0	0	0 No BMP	100
W4	0	0	0	0	0 No BMP	100
W5	0	0	0	0	0 No BMP	100
W6	0	0	0	0	0 No BMP	100
W7	0	0	0	0	0 No BMP	100
W8	0	0	0	0	0 No BMP	100
W9	0	0	0	0	0 No BMP	100
W10	0	0	0	0	0 No BMP	100
W11	0	0	0	0	0 No BMP	100
W12	0	0	0	0	0 No BMP	100
W13	0	0	0	0	0 No BMP	100

4. BMPs and efficiencies for different pollutants on USER DEFINED land use, ND=No Data

Watershed	User Defined					
	N	P	BOD	Sediment	BMPs	% Area BMP Applied
W1	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W2	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W3	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W4	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W5	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W6	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W7	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W8	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W9	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W10	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W11	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W12	0.852	0.862	0	0.825	Combined BMPs-Calculated	100
W13	0.852	0.862	0	0.825	Combined BMPs-Calculated	100

5. BMPs and efficiencies for different pollutants on FEEDLOTS, ND=No Data

Watershed	Feedlots					
	N	P	BOD	Sediment	BMPs	%Area BMP Applied
W1	0	0	0	0	0 No BMP	100
W2	0	0	0	0	0 No BMP	100
W3	0.45	0.7	ND	ND	Diversion	100
W4	ND	0.85	ND	ND	Filter strip	100
W5	0.45	0.7	ND	ND	Diversion	100
W6	0	0	0	0	0 No BMP	100
W7	0	0	0	0	0 No BMP	100
W8	0.65	0.6	ND	ND	Waste Storage Facility	100
W9	0	0	0	0	0 No BMP	100
W10	0	0	0	0	0 No BMP	100
W11	0	0	0	0	0 No BMP	100
W12	0	0	0	0	0 No BMP	100
W13	0	0	0	0	0 No BMP	100

6. BMPs and efficiencies for different pollutants on URBAN

To change/set BMP/LID for urban land uses, click the 'Urban BMP Tool' button on the top-left of this sheet.

7. Combined watershed BMP efficiencies from the BMP calculator

Watershed	Watershed Combined BMP Efficiencies				
	N	P	BOD	Sediment	BMPs
W1-Crop	0.864	0.862	0	0.911	Combined BMPs
W2-Crop	0.864	0.862	0	0.91	Combined BMPs
W3-Crop	0.861	0.86	0	0.906	Combined BMPs
W4-Crop	0.862	0.86	0	0.907	Combined BMPs
W5-Crop	0.863	0.861	0	0.909	Combined BMPs
W6-Crop	0.864	0.862	0	0.912	Combined BMPs
W7-Crop	0.865	0.862	0	0.912	Combined BMPs
W8-Crop	0.863	0.861	0	0.909	Combined BMPs
W9-Crop	0.863	0.861	0	0.91	Combined BMPs
W10-Crop	0.842	0.847	0	0.876	Combined BMPs
W11-Crop	0.858	0.858	0	0.901	Combined BMPs
W12-Crop	0.863	0.861	0	0.909	Combined BMPs
W13-Crop	0.865	0.863	0	0.913	Combined BMPs
W1-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W2-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W3-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W4-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W5-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W6-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W7-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W8-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W9-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W10-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W11-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W12-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W13-Pasture	0.5325	0.6125	0	0.65	Combined BMPs
W1-Forest	0	0	0	0	Combined BMPs
W2-Forest	0	0	0	0	Combined BMPs
W3-Forest	0	0	0	0	Combined BMPs
W4-Forest	0	0	0	0	Combined BMPs
W5-Forest	0	0	0	0	Combined BMPs
W6-Forest	0	0	0	0	Combined BMPs
W7-Forest	0	0	0	0	Combined BMPs
W8-Forest	0	0	0	0	Combined BMPs
W9-Forest	0	0	0	0	Combined BMPs
W10-Forest	0	0	0	0	Combined BMPs
W11-Forest	0	0	0	0	Combined BMPs
W12-Forest	0	0	0	0	Combined BMPs
W13-Forest	0	0	0	0	Combined BMPs
W1-User	0.852	0.862	0	0.825	Combined BMPs
W2-User	0.852	0.862	0	0.825	Combined BMPs
W3-User	0.852	0.862	0	0.825	Combined BMPs
W4-User	0.852	0.862	0	0.825	Combined BMPs
W5-User	0.852	0.862	0	0.825	Combined BMPs
W6-User	0.852	0.862	0	0.825	Combined BMPs
W7-User	0.852	0.862	0	0.825	Combined BMPs
W8-User	0.852	0.862	0	0.825	Combined BMPs
W9-User	0.852	0.862	0	0.825	Combined BMPs
W10-User	0.852	0.862	0	0.825	Combined BMPs
W11-User	0.852	0.862	0	0.825	Combined BMPs
W12-User	0.852	0.862	0	0.825	Combined BMPs
W13-User	0.852	0.862	0	0.825	Combined BMPs

Total Load	This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

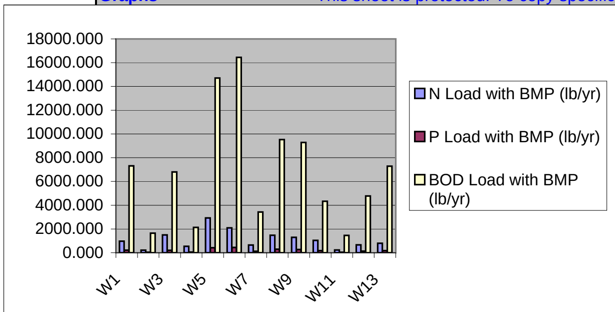
1. Total load by subwatershed(s)

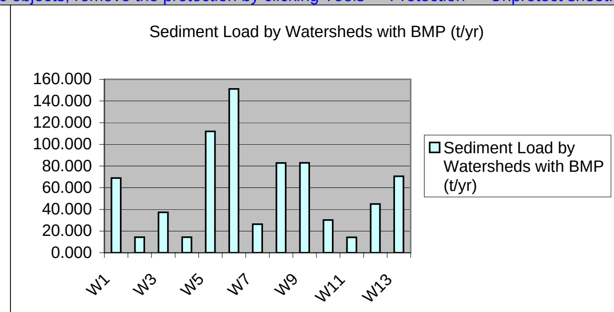
Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	5013.6	1275.6	11073.4	655.8	4044.0	1061.8	3755.8	586.8	969.6	213.8	7317.6	68.9	80.7	83.2	33.9	89.5
W2	1056.2	258.2	2393.9	131.5	836.6	214.2	750.1	117.2	219.6	44.0	1643.8	14.3	79.2	83.0	31.3	89.1
W3	2799.1	498.6	7551.5	154.6	1301.0	290.2	751.0	117.3	1498.1	208.4	6800.5	37.3	46.5	58.2	9.9	75.9
W4	1219.1	265.3	2724.2	106.6	684.5	206.9	589.9	92.2	534.6	58.5	2134.3	14.4	56.1	78.0	21.7	86.5
W5	10365.5	2270.1	20587.1	1031.6	7444.1	1848.0	5886.2	919.7	2921.3	422.1	14701.0	111.9	71.8	81.4	28.6	89.2
W6	11343.0	2862.1	24977.5	1483.7	9251.2	2415.5	8528.2	1332.5	2091.7	446.6	16449.3	151.2	81.6	84.4	34.1	89.8
W7	1673.1	382.1	4365.8	172.6	1027.8	266.1	936.5	146.3	645.3	116.0	3429.4	26.3	61.4	69.6	21.4	84.8
W8	5990.8	1464.8	13609.9	719.8	4521.1	1172.1	4077.1	637.0	1469.7	292.7	9532.8	82.8	75.5	80.0	30.0	88.5
W9	6037.6	1509.8	13660.2	766.4	4742.8	1239.0	4374.0	683.4	1294.8	270.8	9286.2	83.0	78.6	82.1	32.0	89.2
W10	1387.7	259.3	4604.9	72.5	346.9	81.0	271.2	42.4	1040.9	178.3	4333.8	30.1	25.0	31.2	5.9	58.5
W11	919.9	229.6	2109.3	115.5	696.5	183.4	648.3	101.3	223.4	46.2	1461.1	14.3	75.7	79.9	30.7	87.7
W12	3179.4	801.4	7121.7	411.2	2513.5	662.1	2344.3	366.3	665.9	139.3	4777.4	44.9	79.1	82.6	32.9	89.1
W13	5544.7	1431.4	11734.6	764.8	4751.7	1253.6	4443.3	694.3	793.0	177.9	7291.3	70.6	85.7	87.6	37.9	90.8
Total	56529.7	13508.4	126514.0	6586.7	42161.7	10893.8	37355.7	5836.8	14368.0	2614.6	89158.4	749.9	74.6	80.6	29.5	88.6

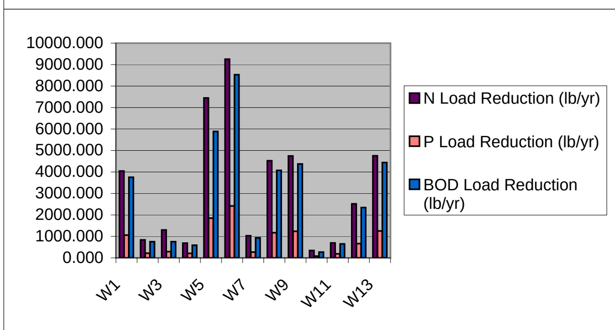
2. Total load by land uses (with BMP)

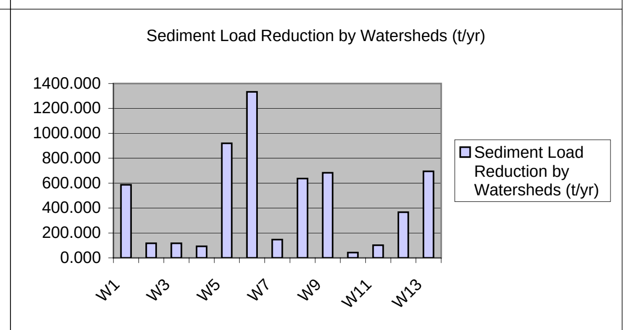
Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	5768.12	887.68	22187.47	132.44
Cropland	5173.24	1240.17	55147.49	572.32
Pastureland	907.30	79.66	5950.66	22.52
Forest	369.91	176.64	888.60	22.61
Feedlots	1872.73	122.03	3854.34	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	276.69	108.37	1129.80	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	14367.99	2614.56	89158.37	749.89

Graphs This sheet is protected. To copy specific objects, remove the protection by clicking Tools -> Protection -> Unprotect sheet.

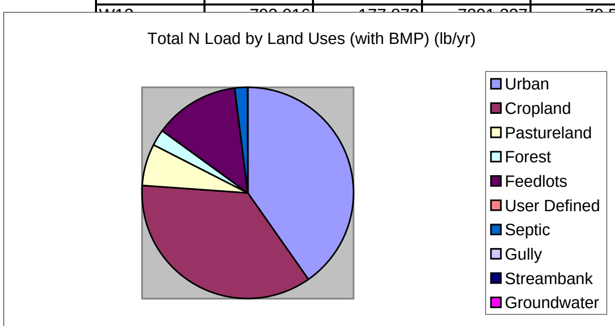


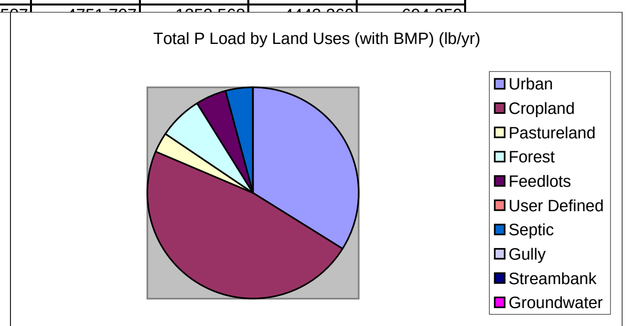


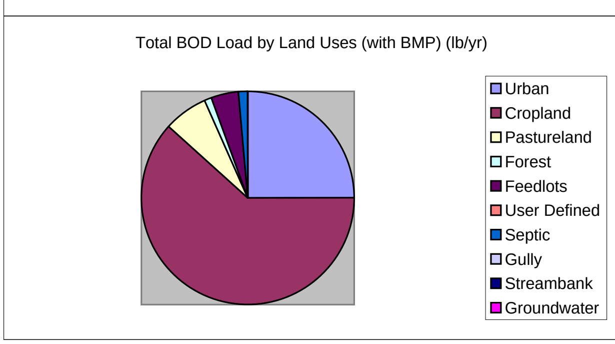


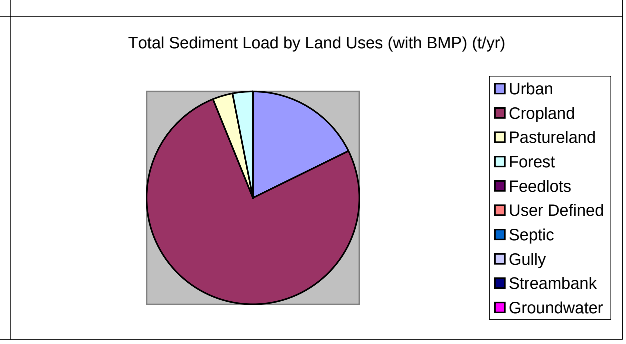


W10	1040.863	178.318	4333.768	30.105	346.887	81.004	271.154	42.368
W11	223.365	46.196	1461.078	14.250	696.495	183.423	648.264	101.291
W12	665.870	139.302	4777.375	44.886	2513.489	662.093	2344.291	366.295









Appendix G

UTRLA Seven Lakes
List of Recommended
BMPs from USDA, NRCS
Field Office Technical Guide

Appendix G
Recommended Best management Practices
Referenced from USDA, Natural Resources Conservation Service
Field Office Technical Guide (FOTG)

To prevent excess pages in the appendices the actual Standards and Specifications were not copied here. The Standards and Specifications are available in the FOTG on line at http://efotg.nrcs.usda.gov/treemenuFS.aspx
A hardcopy of the FOTG may be viewed at any local USDA Service Center location.

This list of BMPs may be related to or used in conjunction with BMPs listed in the UTRLA Watershed Management Plan.

Conservation Cover (Acre)	Code 327
Conservation Crop Rotation (Acre)	Code 328
Drainage Water Management (Acre)	Code 554
Early Successional Habitat Development/Management (Acre)	Code 647
Fence (Feet)	Code 382
Field Border (Feet)	Code 386
Filter Strip (Acre)	Code 393
Forage Harvest Management (Acre)	Code 511
Forest Stand Improvement (Acre)	Code 666
Forest Trails and Landings (Acre)	Code 655
Grassed Waterway (Acre)	Code 412
Nutrient Management (Acre)	Code 590
Pipeline (Feet)	Code 516
Prescribed Grazing (Acre)	Code 528
Residue and Tillage Management, Mulch Till (Acre)	Code 345
Residue and Tillage Management No Till/Strip Till/Direct Seed (Acre)	Code 329
Riparian Forest Buffer (Acre)	Code 391
Riparian Herbaceous Cover (Acre)	Code 390
Stream Channel Stabilization (Feet)	Code 584
Streambank and Shoreline Protection (Feet)	Code 580
Use Exclusion (Acre)	Code 472
Waste Utilization (Acre)	Code 633
Watering Facility (No.)	Code 614
Wetland Restoration (Acre)	Code 657
Wildlife Wetland Habitat Management (Acre)	Code 644

Upper Tippecanoe River Lakes Association Strategies

	Priority			Responsible Party				
Goal 1: Create a weed management program that balances needs of multiple lake users.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Review historic data	X						X	
ID what plants we have where and who's treating them	X						X	
Educate landowners and visitors on values and problems of various weeds			X		X			
ID areas of plant mangement concern	X						X	
Acquire and disseminate info on successful weed control strategies		X			X			
Coordinate plant treatment between adjoining lakes			X			X		
ID groups that have alternative views and bring them into the planning process		X				X		
Share lessons learned on lake by lake basis			X		X	X		
Goal 2: Promote conservation practices to reduce nutrient loading from all watershed residents.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Host technical workshops (with food and beverage)			X		X	X	X	
Coordinate distribution of newsletters, brochures, websites (who has what)	X				X			
Conduct demonstration site field days or advertise/attend others' events (SWCDs, etc.)			X		X	X	X	
Create reusable PowerPoint presentations		X					X	
Develop a stable funding source for projects		X				X		
Engage and utilize SWCD supervisors and staff	X					X		
Design and implement nutrient reduction projects		X					X	
Goal 3: Develop sustainable fish populations that support the recreational needs of lake users.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
ID and understand current and past condition of fish populations		X					X	
Share fishery info in public-friendly way		X			X			
ID who fishes the lakes and what they are catching (spend time on ramps, resident surveys, creel info from DNR)			X		X			
Learn about stocking programs			X		X			
ID differences in fishery expectation of residents and non-residents			X		X			
Explore the use of artificial fish habitat or other habitat improvement projects			X		X		X	
Goal 4: Better understand and educate watershed residents and the general public about the impacts of development and agricultural practices.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Provide experts to come talk to general public and lake residents on specific topics			X				X	
Create a brochure on agricultural statistics and practices aimed at lake residents/lay people			X		X		X	
Conduct a workshop with hands-on water quality modules			X				X	
Help develop a new erosion control ordinance for all land disturbing activities			X		X	X	X	
Build relationships with county officials	X					X		
Participate in county comprehensive planning process		X		X				
Conduct surveys to determine interest and needs for certain topics		X			X			
Goal 5: Promote the development of regulations to control funneling, lakeshore development, and recreational use.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Raise awareness of County officials (particularly Noble Co.) to needs of the lakes (using Kosciusko and Whitley ordinances as examples)	X				X			
Create exchange of info with DNR regarding options for seawalls, erosion control, etc.		X			X			
Contact Conservation Officers for better enforcement of recreational violations (boating, piers, etc.)		X				X		
Contact realtors and developers about ecological impacts and property values			X		X			
Educate area Plan Commissions and Zoning Boards		X			X			
Goal 6: Protect natural shorelines, ditches (inlets and outlets), and natural areas from erosion and other threats.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Determine where the legal shorelines are located		X					X	
Determine what the current legal restrictions are for shorelines and wetlands and who regulated them		X			X		X	
Encourage enforcement of shoreline and wetland restrictions (use local venues)			X			X		
ID all ditches, inlets, outlets, and natural area on master map	X						X	
Better understand funding for ditch maintenance and maintenance process for ditches			X			X		
Increase funding for ditch maintenance and protection projects			X			X		
Determine locations of shoreline erosion and methods to prevent erosion		X					X	
Goal 7: Provide information and technical education through a wide variety of communication strategies.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Provide articles for watershed newsletters and websites		X			X	X		
Develop informational pamphlets		X			X		X	
Host topical workshops			X		X	X	X	
Develop fundraising events for education programs			X			X		
Develop ways to reach kids in schools or 4H			X		X			
Utilize boat ramps (host events at ramp, use kiosks, have messages or survey boxes)		X			X	X		
Get schedule of each lake's annual meeting and other organizations' meetings and plan talks at each	X					X		
Invite media to meetings	X			X				
Goal 8: Involve government officials in environmental issues and initiatives in the watershed.	**Now**	**Soon**	**Later**	**Individual**	**Sub Committee**	**Steering Committee**	**Consultant**	**Other**
Develop list of key players and contact info	X				X			
Invite county officials to UTRLA meetings	X			X				
Form sub committees and ID individual responsible for contacting law makers and media		X				X		
Set one-on-one meetings with law makers in the off-season			X	X				
Craft standard messages for all members to deliver		X			X			
Invite legislators to events		X		X				
Host Congressional field day			X		X	X		
Email officials regular updates	X			X				
Send UTRLA products to officials		X		X				